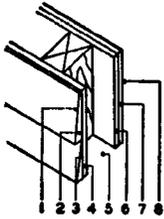


APPENDIX E
HEAT TRANSFER COEFFICIENTS

Table E-1. Coefficients of Transmission (U) of Frame Walls

These coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph

Example—Wall D 4		Example of Substitution	
	Construction	Resistance (R)	
	1. Outside surface (15 mph wind)	0.17	Replace items 3 and 4 with insul. bd. sheathing (3/8 in.) and items 6 and 7 with gypsum wall board 1/2 in.)
	2. Siding, wood, 1/2 in. X 8 in. lapped (avg R)	0.85	Total resistance
	3. Building paper	0.06	Deduct 3. Building paper
	4. Wood sheathing (3/8 in.)	0.98	4. Wood sheathing (3/8 in.)
	5. Air space ^a	0.97	6. Gypsum lath (3/8 in.)
	6. Gypsum lath (3/8 in.)	0.32	7. Plaster (sand agg.) (1/2 in.)
	7. Plaster (sand agg.) (1/2 in.)	0.09	7. Plaster (sand agg.) (1/2 in.)
	8. Inside surface (still air)	0.68	Difference
	Total resistance	4.12	Add 4. Insul. bd. sheathing (3/8 in.)
U = 1/R = 1/4.12 =	0.24	6. Gypsum bd. (1/2 in.)	
See value 0.24 in boldface type in table below.		Total resistance	5.18
		U = 1/R = 1/5.18 =	0.19

To Adjust U Values for Construction with Added Insulation between Framing Members, See Table E-12

Exterior ^b		Interior Finish		Type of Sheathing ^d						Number		
				None, Building Paper	Gypsum Board 1/2 in.	Plywood 1 5/8 in.	Wood, 3/8 in. and Building Paper	Insulation Board Sheathing				
		Resistance ↓		0.06	0.45	0.39	1.04	1.32	2.06			
Material	R	avg R	Material	R	U	U	U	U	U			
					A	B	C	D	E	F		
			None	—	0.57	0.47	0.48	0.36	0.33	0.27	1	
			Gypsum bd. (3/8 in.)	0.32	0.33	0.29	0.30	0.25	0.23	0.20	2	
			Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.)	0.64	0.30	0.27	0.27	0.23	0.22	0.19	3	
			Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.)	0.41	0.32	0.28	0.29	0.24	0.23	0.19	4	
Wood siding Drop—(1 in. X 8 in.)	0.79	0.85 ^c	Metal lath and 3/4 in. plas. (lt. wt. agg.)	0.47	0.31	0.28	0.28	0.24	0.22	0.19	5	
Bevel (1/2 in. X 8 in.)	0.81		Metal lath and 3/4 in. plas. (sand agg.)	0.13	0.35	0.31	0.31	0.26	0.24	0.21	6	
Wood shingles 7 1/2 in. exposure	0.87		Insul. bd. (1/2 in.)	1.43	0.24	0.22	0.22	0.19	0.18	0.16	7	
Wood panels (3/4 in.)	0.94		Insul. bd. lath (1/2 in.) and 1/2 in. plas. (sand agg.)	1.52	0.24	0.22	0.22	0.19	0.18	0.16	8	
				Plywood (1/2 in.)	0.31	0.33	0.29	0.30	0.25	0.23	0.20	9
				Wood panels (3/4 in.)	0.94	0.27	0.25	0.25	0.22	0.20	0.18	10
				Wood lath and 1/2 in. plas. (sand agg.)	0.40	0.32	0.28	0.29	0.24	0.23	0.19	11
				None	—	0.73	0.56	0.58	0.42	0.38	0.30	12
				Gypsum bd. (3/8 in.)	0.32	0.37	0.33	0.33	0.27	0.25	0.21	13
				Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.)	0.64	0.33	0.30	0.30	0.25	0.24	0.20	14
				Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.)	0.41	0.36	0.32	0.32	0.27	0.25	0.21	15
Face-brick veneer ^e	0.44	0.45 ^c	Metal lath and 3/4 in. plas. (lt. wt. agg.)	0.47	0.35	0.31	0.32	0.26	0.25	0.21	16	
Plywood (3/8 in.)	0.47		Metal lath and 3/4 in. plas. (sand agg.)	0.13	0.40	0.35	0.36	0.29	0.27	0.22	17	
				Insul. bd. (1/2 in.)	1.43	0.26	0.24	0.24	0.21	0.20	0.17	18
				Insul. bd. lath (1/2 in.) and 1/2 in. plas. (sand agg.)	1.52	0.26	0.23	0.24	0.21	0.19	0.17	19
				Plywood (1/2 in.)	0.31	0.38	0.33	0.33	0.27	0.26	0.21	20
				Wood panels (3/4 in.)	0.94	0.30	0.27	0.28	0.23	0.22	0.19	21
			Wood lath and 1/2 in. plas. (sand agg.)	0.40	0.36	0.32	0.32	0.27	0.25	0.21	22	

Table E-1. Coefficients of Transmission (U) of Frame Walls—Continued

Exterior ^b		Interior Finish		Type of Sheathing ^d						Number	
				None, Building Paper	Gyp- sum Board ½ in.	Ply- wood 1½ in.	Wood, ¾ in. and Build- ing Paper	Insulation Board Sheathing			
		Resistance ↓		0.06	0.45	0.39	1.04	1.32	2.06		
Material	R	avg R	Material	R	U	U	U	U	U	U	
					A	B	C	D	E	F	
Wood shingles over insul.; backer bd. (½ in.) Asphalt insul. siding	1.40	1.42 ^c	None	—	0.43	0.37	0.38	0.30	0.28	0.23	23
			Gypsum bd. (¾ in.)	0.32	0.28	0.25	0.25	0.22	0.20	0.18	24
	1.46		Gypsum lath (¾ in.) and ½ in. plas. (lt. wt. agg.)	0.64	0.25	0.23	0.23	0.20	0.19	0.17	25
			Gypsum lath (¾ in.) and ½ in. plas. (sand agg.)	0.41	0.27	0.24	0.25	0.21	0.20	0.18	26
			Metal lath and ½ in. plas. (lt. wt. agg.)	0.47	0.27	0.24	0.24	0.21	0.20	0.17	27
			Metal lath and ½ in. plas. (sand agg.)	0.13	0.29	0.26	0.27	0.23	0.21	0.18	28
			Insul. bd. (½ in.)	1.43	0.21	0.20	0.20	0.18	0.17	0.15	29
			Insul. bd. lath (½ in.) and ½ in. plas. (sand agg.)	1.52	0.21	0.19	0.19	0.17	0.16	0.15	30
			Plywood (¾ in.)	0.31	0.28	0.25	0.25	0.22	0.20	0.18	31
			Wood panels (¾ in.)	0.94	0.24	0.22	0.22	0.19	0.18	0.16	32
		Wood lath and ½ in. plas. (sand agg.)	0.40	0.27	0.24	0.25	0.21	0.20	0.18	33	
Asbestos-cement siding Stucco 1 in. Asphalt roll siding	0.21	0.19 ^c	None	—	0.91	0.67	0.70	0.48	0.42	0.32	34
			Gypsum bd. (¾ in.)	0.32	0.42	0.36	0.37	0.30	0.27	0.23	35
	0.20		Gypsum lath (¾ in.) and ½ in. plas. (lt. wt. agg.)	0.64	0.37	0.32	0.33	0.27	0.25	0.21	36
			Gypsum lath (¾ in.) and ½ in. plas. (sand agg.)	0.41	0.40	0.35	0.36	0.29	0.27	0.22	37
	0.15		Metal lath and ½ in. plas. (lt. wt. agg.)	0.47	0.39	0.34	0.35	0.28	0.26	0.22	38
			Metal lath and ½ in. plas. (sand agg.)	0.13	0.45	0.39	0.40	0.31	0.29	0.24	39
			Insul. bd. (½ in.)	1.43	0.29	0.26	0.26	0.22	0.21	0.18	40
			Insul. bd. lath (½ in.) and ½ in. plas. (sand agg.)	1.52	0.28	0.25	0.26	0.22	0.21	0.18	41
			Plywood (¾ in.)	0.31	0.42	0.36	0.37	0.30	0.27	0.23	42
			Wood panels (¾ in.)	0.94	0.33	0.29	0.30	0.25	0.23	0.20	43
		Wood lath and ½ in. plas. (sand agg.)	0.40	0.40	0.35	0.36	0.29	0.27	0.22	44	
Aluminum or steel siding over sheathing Hollow backed Ins. board backed, nominal ¾ in. Reflective foil ins. board backed	0.61	1.8 ^c	None	—	0.37	0.32	0.33	0.27	0.25	0.21	45
			Gypsum bd. (¾ in.)	0.32	0.25	0.23	0.23	0.20	0.19	0.17	46
			Gypsum lath (¾ in.) and ½ in. plas. (lt. wt. agg.)	0.64	0.23	0.21	0.22	0.19	0.18	0.16	47
			Gypsum lath (¾ in.) and ½ in. plas. (sand agg.)	0.41	0.24	0.22	0.23	0.20	0.19	0.16	48
			Metal lath and ½ in. plas. (lt. wt. agg.)	0.47	0.24	0.22	0.22	0.20	0.18	0.16	49
			Metal lath and ½ in. plas. (sand agg.)	0.13	0.26	0.24	0.24	0.21	0.20	0.17	50
			Insul. bd. (½ in.)	1.43	0.20	0.18	0.18	0.16	0.16	0.14	51
			Insul. bd. lath (½ in.) and ½ in. plas. (sand agg.)	1.52	0.19	0.18	0.18	0.16	0.15	0.13	52
			Plywood (¾ in.)	0.31	0.25	0.23	0.23	0.20	0.19	0.17	53
			Wood panels (¾ in.)	0.94	0.22	0.20	0.20	0.18	0.17	0.15	54
		Wood lath and ½ in. plas. (sand agg.)	0.40	0.24	0.22	0.23	0.20	0.19	0.16	55	

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

^b Note that although several types of exterior finish may be grouped because they have approximately the same thermal resistance value, it is not implied that all types may be suitable for application over all types of sheathing listed.

^c Average resistance of items listed. This average was used in computation of U values shown.

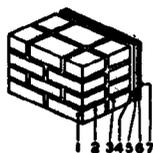
^d Building paper is not included except where noted.

^e Small air space between building paper and brick veneer neglected.

^f Where stucco is applied over insulating board or gypsum sheathing, building paper is generally required, but the change in U value is negligible.

Table E-2. Coefficients of Transmission (U) of Solid Masonry Walls

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit) degree difference in temperature between the air on the two sides, and are based on an outside wind velocity of 15 mph



Example—Wall G 2		Example of Substitution	
Construction	Resistance (R)	Assume plain wall—no furring or plaster.	
1. Outside surface (15 mph wind).....	0.17	Total resistance.....	3.47
2. Face brick (4 in.).....	0.44	Deduct 4. Air space.....	0.97
3. Common brick (4 in.).....	0.80	5. Gypsum lath (3/8 in.).....	0.32
4. Air space ^a	0.97	6. Plas. (sand agg.) (1/2 in.).....	0.09
5. Gypsum lath (3/8 in.).....	0.32		1.38
6. Plas. (sand agg.) (1/2 in.).....	0.09	Total resistance.....	2.09
7. Inside surface (still air).....	0.68	$U = 1/R = 1/2.09 =$	0.48
Total resistance.....	3.47		
$U = 1/R = 1/3.47 =$	0.29		

See value 0.29 in boldface type in table below.

To Adjust U Values for Construction with Added Insulation between Furring Strips, See Table E-12.

Exterior Construction ^b		Interior Finish											Number
		None	Plas. 5/8 in. on Wall		Metal Lath and 3/4 in. Plas. on Furring		Gypsum Lath (3/8 in. and 1/2 in. Plas. on Furring)			Insul. Bd. Lath (1/2 in.) and 1/2 in. Plas. on Furring		Wood Lath and 1/2 in. Plas.	
			(Sand agg.) 0.77	(Lt. wt. agg.) 0.39	(Sand agg.) 0.73	(Lt. wt. agg.) 0.47	No plas.	(Sand agg.) 0.41	(Lt. wt. agg.) 0.64	No plas.	(Sand agg.) 1.43	1.52	
Material	Resistance R	U	U	U	U	U	U	U	U	U	U	U	
Brick (face and common)^c		A	B	C	D	E	F	G	H	I	J	K	
(6 in.)	0.61	0.68	0.64	0.54	0.39	0.34	0.36	0.35	0.33	0.26	0.25	0.35	1
(8 in.)	1.24	0.48	0.45	0.41	0.31	0.28	0.30	0.29	0.27	0.22	0.22	0.29	2
(12 in.)	2.04	0.35	0.33	0.30	0.25	0.23	0.24	0.23	0.22	0.19	0.19	0.23	3
(16 in.)	2.84	0.27	0.26	0.25	0.21	0.19	0.20	0.20	0.19	0.16	0.16	0.20	4
Brick (common only)													
(8 in.)	1.60	0.41	0.39	0.35	0.28	0.26	0.27	0.26	0.25	0.21	0.20	0.26	5
(12 in.)	2.40	0.31	0.30	0.27	0.23	0.21	0.22	0.22	0.21	0.18	0.17	0.22	6
(16 in.)	3.20	0.25	0.24	0.23	0.19	0.18	0.19	0.18	0.18	0.16	0.15	0.18	7
Stone (lime and sand)													
(8 in.)	0.64	0.67	0.63	0.53	0.39	0.34	0.36	0.35	0.32	0.26	0.25	0.35	8
(12 in.)	0.86	0.56	0.52	0.45	0.34	0.31	0.32	0.31	0.29	0.24	0.23	0.31	9
(16 in.)	1.28	0.47	0.45	0.40	0.31	0.28	0.29	0.28	0.27	0.22	0.22	0.29	10
(24 in.)	1.98	0.36	0.35	0.32	0.26	0.24	0.25	0.24	0.23	0.19	0.19	0.24	11
Hollow clay tile													
(8 in.)	1.85	0.36	0.36	0.32	0.26	0.24	0.25	0.25	0.23	0.20	0.19	0.25	12
(10 in.)	2.22	0.33	0.31	0.29	0.24	0.22	0.23	0.22	0.21	0.18	0.18	0.23	13
(12 in.)	2.60	0.30	0.29	0.27	0.22	0.21	0.22	0.21	0.20	0.17	0.17	0.21	14
Poured concrete													
30 lb per cu ft													
(4 in.)	4.44	0.19	0.19	0.18	0.16	0.15	0.15	0.15	0.14	0.13	0.13	0.15	15
(6 in.)	6.66	0.13	0.13	0.13	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.11	16
(8 in.)	8.88	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.09	17
(10 in.)	11.10	0.08	0.08	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.07	0.08	18
80 lb per cu ft													
(6 in.)	2.40	0.31	0.30	0.27	0.23	0.21	0.22	0.22	0.21	0.18	0.17	0.22	19
(8 in.)	3.20	0.25	0.24	0.23	0.19	0.18	0.19	0.18	0.18	0.16	0.15	0.18	20
(10 in.)	4.00	0.21	0.20	0.19	0.17	0.16	0.16	0.16	0.15	0.14	0.14	0.16	21
(12 in.)	4.80	0.18	0.17	0.17	0.15	0.14	0.14	0.14	0.14	0.12	0.12	0.14	22
140 lb per cu ft													
(6 in.)	0.48	0.75	0.69	0.58	0.41	0.36	0.38	0.37	0.34	0.27	0.26	0.37	23
(8 in.)	0.64	0.67	0.63	0.53	0.39	0.34	0.36	0.35	0.32	0.26	0.25	0.35	24
(10 in.)	0.80	0.61	0.57	0.49	0.36	0.32	0.34	0.33	0.31	0.25	0.24	0.33	25
(12 in.)	0.96	0.55	0.52	0.45	0.34	0.31	0.32	0.31	0.29	0.24	0.23	0.31	26

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

^b If stucco or structural glass is applied to the exterior, the additional resistance value of 0.10 would have a negligible effect on the U value.

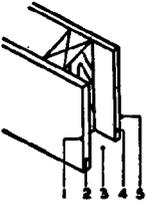
^c Brick, 6 in. (5 1/2 in. actual) is assumed to have no backing. Walls 8, 12 and 16 in. have 4 in. of face brick and balance of common brick.

Table E-2. Coefficients of Transmission (U) of Solid Masonry Walls—Continued

Exterior Construction ^b		Interior Finish											Number
		None	Plas. 5/8 in. on Wall		Metal Lath and 3/4 in. Plas. on Furring		Gypsum Lath (3/8 in.) and 1/2 in. Plas. on Furring			Insvl. Bd. Lath (1/2 in.) and 1/2 in. Plas. on Furring		Wood Lath and 1/2 in. Plas.	
			(Sand agg.)	(Lt. wt. agg.)	(Sand agg.)	(Lt. wt. agg.)	No plas.	(Sand agg.)	(Lt. wt. agg.)	No plas.	(Sand agg.)	(Sand agg.)	
			0.17	0.39	0.13	0.47	0.32	0.41	0.64	1.43	1.52	0.40	
Material	R	U	U	U	U	U	U	U	U	U	U		
		A	B	C	D	E	F	G	H	I	J		K
Concrete block													
(Gravel agg.) (8 in.)	1.11	0.52	0.48	0.43	0.33	0.29	0.31	0.30	0.28	0.23	0.22	0.30	27
(12 in.)	1.28	0.47	0.45	0.40	0.31	0.28	0.29	0.28	0.27	0.22	0.22	0.29	28
(Cinder agg.) (8 in.)	1.72	0.39	0.37	0.34	0.27	0.25	0.26	0.25	0.24	0.20	0.20	0.25	29
(12 in.)	1.89	0.36	0.35	0.32	0.26	0.24	0.25	0.24	0.23	0.19	0.19	0.24	30
(Lt. wt. agg.) (8 in.)	2.00	0.35	0.34	0.31	0.26	0.23	0.24	0.24	0.22	0.19	0.19	0.24	31
(12 in.)	2.27	0.32	0.31	0.28	0.24	0.22	0.23	0.22	0.21	0.18	0.18	0.22	32

Table E-3. Coefficients of Transmission (U) of Frame Partitions or Inner Walls

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on still air (no wind) conditions on both sides

Example—Wall B 1		Example of Substitution	
	Construction	Resistance (R)	
	1. Surface (still air).....	0.68	Replace item 2 with wood fiber hardboard (1/4 in.).
	2. Gypsum bd. (3/8 in.).....	0.38	Total resistance.....
	3. Air space ^a	0.97	Deduct 2. Gypsum wall board (3/8 in.).....
	4. Gypsum wall board (3/8 in.).....	0.38	Difference.....
	5. Surface (still air).....	0.68	Add 2. Hardboard (1/4 in.).....
	Total resistance.....	2.87	Total resistance.....
$U = 1/R = 1/2.87$	0.34	$U = 1/R = 1/2.85 =$	
See value 0.34 in boldface type in table below.			

To Adjust U Values for Construction with Added Insulation between Members, See Table E-12.

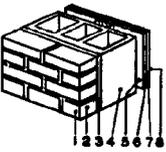
Type of Interior Finish		Single Partition (Finish on Only One Side of Stud)	Double Partition (Finish on Both Sides of Stud)	Number
Material	R	U	U	
		A	B	
Gypsum bd. (3/8 in.).....	0.32	0.60	0.34	1
Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.).....	0.64	0.50	0.28	2
Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.).....	0.41	0.56	0.32	3
Metal lath and 3/4 in. plas. (lt. wt. agg.).....	0.47	0.55	0.31	4
Metal lath and 3/4 in. plas. (sand agg.).....	0.13	0.67	0.39	5
Insul. bd. (3/4 in.).....	1.43	0.36	0.19	6
Insul. bd. lath (3/2 in.) and 1/2 plas. (sand agg.).....	1.52	0.35	0.19	7
Plywood: (1/4 in.).....	0.31	0.60	0.34	8
(3/8 in.).....	0.47	0.55	0.31	9
(1/2 in.).....	0.63	0.50	0.28	10
Wood panels (1/4 in.).....	0.94	0.43	0.24	11
Wood-lath and 1/2 in. plas. (sand agg.).....	0.40	0.57	0.32	12
Sheet-metal panels adhered to wood (framing).....	0	0.74	0.43	13
Glass and glass blocks.....				

See Table E-15

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

Table E-4. Coefficients of Transmission (U) of Masonry Walls.

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph

Example—Wall G 1			Example of Substitution			
	Construction		Resistance (R)			
	1. Outside surface (15 mph wind)		0.17	Replace items 6 and 7 with wood panels (1/4 in.) and vapor barrier applied over furring strips		
	2. Face brick (4 in.) (avg R)		0.39	Total resistance		
	3. Cement mortar (1/2 in.)		0.10	Deduct 6. Gypsum lath (1/2 in.)		
	4. Concrete block (cinder agg.) (4 in.)		1.11	7. Plas. (sand agg.) (1/2 in.)		
	5. Air space ^a		0.97	Difference		
	6. Gypsum lath (1/2 in.)		0.32	Add 6. Vapor barrier		
	7. Plas. (sand agg.) (1/2 in.)		0.09	7. Wood panel (1/4 in.)		
	8. Inside surface (still air)		0.68	Total resistance		
Total resistance			\$ 8.83	4.42		
$U = 1/R = 1/8.83 =$			0.26	$U = 1/R = 1/4.42 =$		
See value 0.26 in boldface type in table below.				0.23		

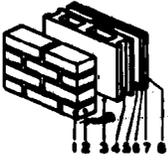
To Adjust U Values for Construction with Added Insulation between Furring Strips, See Table E-12.

Exterior Facing		Backing		Interior Finish											Number
				None	Plas. 3/8 in. on Wall		Metal Lath and 1/2 in. Plas. on Furring		Gypsum Lath (3/8 in.) and 1/2 in. Plas. on Furring			Insul. Bd. Lath (1/2 in.) and 1/2 in. Plas. on Furring		Wood Lath 1/2 in. Plas.	
					(Sand agg.)	(Lt. wt. agg.)	(Sand agg.)	(Lt. wt. agg.)	No plas.	(Sand agg.)	(Lt. wt. agg.)	No plas.	(Sand agg.)	(Sand agg.)	
Material	R	avg R	U	U	U	U	U	U	U	U	U	U	U	U	
			A	B	C	D	E	F	G	H	I	J	K		
Concrete block (Cinder agg.) (4 in.) (8 in.) (12 in.) (Lt. wt. agg.) (4 in.) (8 in.) (12 in.) (Sand agg.) (4 in.) (8 in.) (12 in.) Hollow clay tile (4 in.) (8 in.) (12 in.) Concrete (Sand agg.) (4 in.) (6 in.) (8 in.)	0.44	0.59	1.11	0.41	0.39	0.35	0.28	0.26	0.27	0.26	0.25	0.21	0.20	0.26	1
			1.72	0.33	0.32	0.29	0.24	0.22	0.23	0.23	0.21	0.18	0.18	0.23	2
			1.89	0.31	0.30	0.28	0.23	0.21	0.22	0.22	0.21	0.18	0.17	0.22	3
			1.60	0.35	0.34	0.31	0.25	0.23	0.24	0.24	0.22	0.19	0.19	0.24	4
			2.00	0.30	0.29	0.27	0.23	0.21	0.22	0.21	0.20	0.17	0.17	0.21	5
			2.27	0.28	0.27	0.25	0.21	0.20	0.20	0.20	0.19	0.17	0.16	0.20	6
			0.71	0.49	0.46	0.41	0.32	0.29	0.30	0.29	0.27	0.22	0.22	0.29	7
			1.11	0.41	0.39	0.35	0.28	0.26	0.27	0.26	0.25	0.21	0.20	0.26	8
			1.89	0.38	0.37	0.33	0.27	0.25	0.26	0.25	0.24	0.20	0.20	0.25	9
			1.11	0.41	0.39	0.35	0.28	0.26	0.27	0.26	0.25	0.21	0.20	0.26	10
			1.86	0.31	0.30	0.28	0.23	0.22	0.22	0.22	0.21	0.18	0.18	0.22	11
			2.60	0.26	0.25	0.24	0.20	0.19	0.19	0.19	0.18	0.16	0.16	0.19	12
Concrete block (Cinder agg.) (4 in.) (8 in.) (12 in.) (Lt. wt. agg.) (4 in.) (8 in.) (12 in.) (Sand agg.) (4 in.) (6 in.) (8 in.) Common brick (4 in.) Precast concrete (sand agg.) (8 in.) 8 in.	0.80	0.72	1.11	0.36	0.35	0.32	0.26	0.24	0.25	0.24	0.23	0.19	0.19	0.24	16
			1.72	0.29	0.29	0.26	0.22	0.21	0.21	0.21	0.20	0.17	0.17	0.21	17
			1.89	0.28	0.27	0.25	0.21	0.20	0.21	0.20	0.19	0.17	0.17	0.20	18
			1.60	0.32	0.30	0.28	0.23	0.22	0.22	0.22	0.21	0.18	0.18	0.22	19
			2.00	0.27	0.26	0.25	0.21	0.20	0.20	0.20	0.19	0.16	0.16	0.20	20
			2.27	0.25	0.25	0.23	0.20	0.19	0.19	0.19	0.18	0.16	0.16	0.19	21
			0.71	0.42	0.40	0.36	0.29	0.26	0.27	0.27	0.25	0.21	0.21	0.27	22
			1.11	0.36	0.35	0.32	0.26	0.24	0.25	0.24	0.23	0.19	0.19	0.24	23
			1.89	0.34	0.33	0.30	0.25	0.23	0.24	0.23	0.22	0.19	0.18	0.23	24
			1.11	0.36	0.35	0.32	0.26	0.24	0.25	0.24	0.23	0.19	0.19	0.24	25
			1.86	0.28	0.28	0.26	0.22	0.20	0.21	0.20	0.19	0.17	0.17	0.20	26
			2.60	0.24	0.23	0.22	0.19	0.18	0.18	0.18	0.17	0.15	0.15	0.18	27
Concrete (Sand agg.) (4 in.) (6 in.) (8 in.)	0.64	0.43	0.52	0.48	0.48	0.42	0.32	0.29	0.30	0.30	0.28	0.23	0.22	0.30	28
			0.48	0.47	0.44	0.39	0.31	0.28	0.29	0.28	0.27	0.22	0.22	0.28	29
			0.64	0.43	0.41	0.37	0.29	0.27	0.28	0.28	0.26	0.21	0.21	0.27	30

^aTo adjust U values for the effect of added insulation between framing members, see Table E-12.

Table E-5. Coefficients of Transmission (U) of Masonry Cavity Walls

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph

Example—Wall H 6		Example of Substitution	
		<p>Construction Resistance (R)</p> <p>1. Outside surface (15 mph wind)..... 0.17</p> <p>2. Common brick (4 in.) (avg R)..... 0.76</p> <p>3. Air space^a..... 0.97</p> <p>4. Concrete block (gravel agg.) (4 in.)..... 0.71</p> <p>5. Air space^a..... 0.97</p> <p>6. Gypsum lath (½ in.)..... 0.32</p> <p>7. Plas. (lt. wt. agg.) (½ in.)..... 0.32</p> <p>8. Inside surface (still air)..... 0.68</p> <p>Total resistance..... 4.80</p> <p>$U = 1/R = 1/4.80 =$ 0.20</p> <p>See value 0.20 in boldface type in table below.</p>	<p>Replace item 4 with 8 in. concrete block and items 6 and 7 with ½ in. plas. (sand agg.) applied directly to concrete block</p> <p>Total resistance..... 4.90</p> <p>Deduct 4. Concrete block (gravel agg.) 4 in..... 0.71</p> <p>5. Air space..... 0.97</p> <p>6. Gypsum lath (½ in.)..... 0.32</p> <p>7. Plas. (lt. wt. agg.) (½ in.)..... 0.32 2.52</p> <p>Difference..... 2.58</p> <p>Add 4. Concrete block (gravel agg.) 8 in..... 1.11</p> <p>7. Plas. (sand agg.) (½ in.)..... 0.11 1.22</p> <p>Total resistance..... 3.80</p> <p>$U = 1/R = 1/3.80 =$ 0.26</p>

To Adjust U Values for Construction with Added Insulation^b between Inner and Outer Tiers or between Furring Strips, See Table E-12.

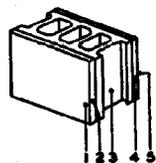
Exterior Construction		Inner Section		Interior Finish											Number			
				None	Plas. ½ in. on Wall		Metal Lath and ¾ in. Plas. on Furring		Gypsum Lath (½ in.) and ½ in. Plas. on Furring			Insul. Bd. Lath and ½ in. Plas. on Furring		Wood Lath and ½ in. Plas.				
					(Sand agg.) 0.77	(Lt. wt. agg.) 0.39	(Sand agg.) 0.13	(Lt. wt. agg.) 0.47	No plas. 0.32	(Sand agg.) 0.47	(Lt. wt. agg.) 0.64	No plas. 1.43	(Sand agg.) 1.52	(Sand agg.) 0.40				
Material	R	avg R	Material	R	U	U	U	U	U	U	U	U	U	U	U			
					A	B	C	D	E	F	G	H	I	J	K			
Face brick (4 in.)	0.44		Concrete block (4 in.)		0.71	0.34	0.32	0.30	0.25	0.23	0.23	0.23	0.22	0.19	0.18	0.23	1	
			(Gravel agg.)		1.11	0.30	0.29	0.27	0.22	0.21	0.21	0.21	0.20	0.17	0.17	0.21	2	
			(Lt. wt. agg.)		1.60	0.27	0.26	0.24	0.21	0.19	0.20	0.19	0.19	0.19	0.16	0.16	0.19	3
			Common brick (4 in.)		0.80	0.33	0.32	0.29	0.24	0.22	0.23	0.23	0.21	0.18	0.18	0.23	4	
			Clay tile (4 in.)		1.11	0.30	0.29	0.27	0.22	0.21	0.21	0.21	0.20	0.17	0.17	0.21	5	
Common brick (4 in.)	0.80		Concrete block (4 in.)		0.71	0.30	0.29	0.27	0.23	0.21	0.22	0.21	0.20	0.18	0.17	0.21	6	
			(Gravel agg.)		1.11	0.27	0.26	0.25	0.21	0.19	0.20	0.20	0.19	0.16	0.16	0.20	7	
			(Lt. wt. agg.)		1.60	0.25	0.24	0.22	0.19	0.18	0.19	0.18	0.18	0.15	0.15	0.18	8	
Concrete block (gravel agg.) (4 in.)	0.71		Common brick (4 in.)		0.80	0.30	0.29	0.27	0.22	0.21	0.21	0.21	0.20	0.17	0.17	0.21	9	
			Clay tile (4 in.)		1.11	0.27	0.26	0.25	0.21	0.19	0.20	0.20	0.19	0.16	0.16	0.20	10	
Concrete block (cinder agg.) (4 in.)	1.11		Concrete block (4 in.)		0.71	0.27	0.27	0.25	0.21	0.20	0.20	0.20	0.19	0.17	0.16	0.20	11	
			(Gravel agg.)		1.11	0.25	0.24	0.23	0.19	0.18	0.19	0.18	0.18	0.16	0.15	0.18	12	
			(Lt. wt. agg.)		1.60	0.23	0.22	0.21	0.18	0.17	0.17	0.17	0.17	0.15	0.14	0.17	13	
			Common brick (4 in.)		0.80	0.27	0.26	0.24	0.21	0.19	0.20	0.20	0.19	0.16	0.16	0.20	14	
			Clay tile (4 in.)		1.11	0.25	0.24	0.23	0.19	0.18	0.19	0.18	0.18	0.16	0.15	0.18	15	

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

^b If insulation is to be used in the cavity it should be a water-resistant type.

Table E-6. Coefficients of Transmission (U) of Masonry Partitions

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides) and are based on still air (no wind) conditions on both sides



Example—Wall C 2		Example of Substitution	
Construction	Resistance (R)		
1. Inside surface (still air)	0.68	Replace item 3 with gypsum tile (4 in.)	
2. Plas. (lt. wt. agg.) 5/8 in.	0.39	Total resistance	3.25
3. Cement block (cinder agg.) (4 in.)	1.11	Deduct 3. Cement block (cinder agg.) (4 in.)	1.11
4. Plas. (lt. wt. agg.) 5/8 in.	0.39	Difference	2.14
5. Inside surface (still air)	0.68	Add 3. Gypsum tile (4 in.)	1.67
Total resistance	3.25	Total resistance	3.81
$U = 1/R = 1/3.25 =$	0.31	$U = 1/R = 1/3.81 =$	0.26
See value 0.31 in boldface type in table below.			

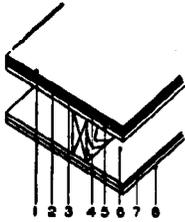
Type of Partition		Surface Finish					Number
		None	Plas. (lt. wt. agg.) 5/8 in.		Plas. (sand agg.) 5/8 in.		
			One side 0.39	Two sides 0.78	One side 0.11	Two sides 0.22	
Material	Resistance ↓ R	U	U	U	U	U	
		A	B	C	D	E	
Hollow concrete block							
(Cinder agg.)							
(3 in.)	0.86	0.45	0.38	0.33	0.43	0.41	1
(4 in.)	1.11	0.40	0.35	0.31	0.39	0.37	2
(8 in.)	1.72	0.32	0.29	0.26	0.31	0.30	3
(12 in.)	1.89	0.31	0.27	0.25	0.30	0.29	4
(Lt. wt. agg.)							
(3 in.)	1.87	0.38	0.33	0.30	0.36	0.35	5
(4 in.)	1.60	0.35	0.31	0.27	0.34	0.32	6
(8 in.)	2.00	0.30	0.27	0.24	0.29	0.28	7
(12 in.)	2.27	0.28	0.25	0.23	0.27	0.26	8
(Gravel agg.)							
(8 in.)	1.11	0.40	0.35	0.31	0.39	0.37	9
(12 in.)	1.28	0.38	0.33	0.29	0.36	0.35	10
Hollow clay tile							
(3 in.)	0.80	0.46	0.39	0.34	0.44	0.42	11
(4 in.)	1.11	0.40	0.35	0.31	0.39	0.37	12
(6 in.)	1.62	0.35	0.31	0.27	0.33	0.32	13
(8 in.)	1.85	0.31	0.28	0.25	0.30	0.29	14
Hollow gypsum tile							
(3 in.)	1.35	0.37	0.32	0.29	0.35	0.34	15
(4 in.)	1.67	0.33	0.29	0.26	0.32	0.31	16
Solid plaster walls							
Gypsum lath (1/2 in.) and plas.							
1/4 in. each side							
(Lt. wt. agg.)	1.39	0.36	—	—	—	—	17
(Sand agg.)	0.71	0.48	—	—	—	—	18
1 in. each side							
(Lt. wt. agg.)	1.73	0.32	—	—	—	—	19
(Sand agg.)	0.81	0.46	—	—	—	—	20
Metal lath and plas.*							
2 in. total thickness							
(Lt. wt. agg.)	1.28	0.38	—	—	—	—	21
(Sand agg.)	0.36	0.58	—	—	—	—	22
2 1/2 in. total thickness							
(Lt. wt. agg.)	1.60	0.34	—	—	—	—	23
(Sand agg.)	0.45	0.55	—	—	—	—	24
Glass and glass blocks							

See Table E-15

*Metal core and supports disregarded. Plaster troweled smooth both sides.

Table E-7. Coefficients of Transmission (U) of Frame Construction Ceilings and Floors

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference between the air on the two sides), and are based on still air (no wind) conditions on both sides

Example—Floor E 5		Example of Substitution	
		Heated room below unheated space Construction (heat flow up) Resistance (R)	
1. Top surface (still air)	0.61	Assume heated room is above unheated space so heat flow is down	
2. Linoleum or tile (avg R)	0.05	Total resistance	4.41
3. Felt	0.01	Deduct 1. Top surface (heat flow up)	0.61
4. Plywood (1/4 in.)	0.78	6. Air space (heat flow up)	0.85
5. Wood subfloor (3/32 in.)	0.98	8. Bottom surface (heat flow up)	0.61
6. Air space (7 1/2 in.)	0.85		2.07
7. Metal lath and 1/2 in. plas. (lt. wt. agg.)	0.47	Difference	2.34
8. Bottom surface (still air)	0.61	Add 1. Top surface (heat flow down)	0.92
Total resistance	4.41	6. Air space (heat flow down)	1.25
$U = 1/R = 1/4.41 =$	0.23	8. Bottom surface (heat flow down)	0.92
See value 0.23 in boldface type in table below.		Total resistance	5.43
		$U = 1/R = 1/5.43 =$	0.18

To Adjust U Values for Construction with Added Insulation between Framing Members, See Table E-12.

Direction of Heat		Heat Flow Upward (Winter Conditions)						Heat Flow Downward (Summer Conditions)						Number
Type of Ceiling		Type of Floor												
		Wood subfloor (26/32 in.), felt, and—						Wood subfloor (26/32 in.), felt, and—						
		None	Wood subfloor (26/32 in.)	Cement (1 1/2 in.) and ceramic tile (1/2 in.)	Hardwood floor (3/4 in.)	Plywood (3/4 in.) and floor tile or linoleum (1/2 in.)	Insul. bd. (3/4 in.) and hard bd. (1/2 in.) and floor tile or linoleum (1/2 in.)	None	Wood subfloor (26/32 in.)	Cement (1 1/2 in.) and ceramic tile (1/2 in.)	Hardwood floor (3/4 in.)	Plywood (3/4 in.) and floor tile or linoleum (1/2 in.)	Insul. bd. (3/4 in.) and hard bd. (1/2 in.) and floor tile or linoleum (1/2 in.)	
Resistance	U	U	U	U	U	U	U	U	U	U	U	U		
Material	R	A	B	C	D	E	F	G	H	I	J	K	L	
None	—	—	0.45	0.38	0.34	0.32	0.29	—	0.35	0.31	0.28	0.26	0.24	1
Gypsum bd. (3/8 in.)	0.38	0.65	0.30	0.27	0.24	0.23	0.22	0.46	0.24	0.22	0.21	0.20	0.19	2
Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.)	0.64	0.54	0.27	0.24	0.23	0.22	0.20	0.40	0.22	0.21	0.19	0.19	0.17	3
Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.)	0.41	0.61	0.29	0.26	0.24	0.23	0.21	0.44	0.24	0.22	0.20	0.20	0.18	4
Metal lath and 3/8 in. plas. (lt. wt. agg.)	0.47	0.59	0.28	0.26	0.23	0.23	0.21	0.43	0.23	0.21	0.20	0.19	0.18	5
Metal lath and 3/8 in. plas. (sand agg.)	0.13	0.74	0.31	0.28	0.26	0.25	0.22	0.51	0.25	0.23	0.21	0.21	0.19	6
Insul. bd. (1/2 in.)	1.43	0.38	0.22	0.20	0.19	0.19	0.17	0.31	0.19	0.18	0.17	0.16	0.15	7
Insul. bd. lath (1/2 in.) and 1/2 in. plas. (sand agg.)	1.58	0.36	0.22	0.20	0.19	0.18	0.17	0.30	0.19	0.17	0.17	0.16	0.15	8
Acoustical tile														
(1/2 in.) on gypsum bd. (3/8 in.)	1.51 ^a	0.37	0.22	0.20	0.19	0.18	0.17	0.30	0.19	0.17	0.17	0.16	0.15	9
(1/2 in.) on furring	1.19	0.41	0.24	0.22	0.20	0.19	0.18	0.33	0.20	0.19	0.17	0.17	0.16	10
(3/4 in.) on gypsum bd. (3/8 in.)	2.10 ^c	0.30	0.19	0.18	0.17	0.17	0.15	0.25	0.17	0.16	0.15	0.15	0.14	11
(3/4 in.) on furring	1.78	0.33	0.21	0.19	0.18	0.17	0.16	0.28	0.18	0.17	0.16	0.15	0.15	12
Wood lath and 1/2 in. plas. (sand agg.)	0.40	0.62	0.29	0.26	0.24	0.23	0.21	0.45	0.24	0.22	0.20	0.20	0.18	13

^a To adjust U values for the effect of added insulation between framing members, see Table E-12

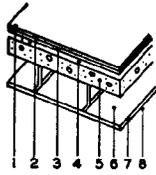
^b Includes asphalt, rubber, and plastic tile (1/2 in.), ceramic tile, or terrazzo (1 in.).

^c Includes thermal resistance of 1/2 in. gypsum wall board.

Table E-8. Coefficients of Transmission (U) of Concrete Floor-Ceiling Constructions

A Winter condition, upward flow

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on still air (no wind) conditions on both sides



Example—Floor J 4

Heated room below unheated space
Construction (heat flow up) Resistance (R)

1. Top surface (still air)..... 0.61
2. Asphalt tile and felt..... 0.11
3. Plywood (5/8 in.)..... 0.78
4. Air space^b..... 0.85
5. Concrete slab 4 in. (avg R)..... 0.40
6. Air space^a (8 in.)..... 0.85
7. Metal lath and 3/4 plas. (sand agg.)..... 0.18
8. Bottom surface (still air)..... 0.61

Total resistance..... 4.34
 $U = 1/R = 1/4.34 =$ 0.23
 See value 0.23 in boldface type in table below.

Example of Substitution

Replace items 2, 3, and 4 with hardwood block (1 3/8 in.) on slab

Total resistance..... 4.34

Deduct 2. Asphalt tile and felt..... 0.11

3. Plywood (5/8 in.)..... 0.78

4. Air space..... 0.85

1.74

Difference..... 2.60

Add 2. Wood block (1 3/8 in.)..... 0.74

Total resistance..... 3.34

$U = 1/R = 1/3.34 =$ 0.30

To Adjust U Values for Construction with Added Insulation in Air Space above Suspended Ceiling, See Table E-12.

Type of Deck		Type of Finish Floor		Type of Ceiling																Number
				Ceiling Applied Directly to Slab						Suspended Ceiling										
				Plas.		Acoustical tile—glued		No plas.	Gypsum bd. (5/8 in.) and Plas.		Metal lath and plas.		Acoustical tile							
				(lt. wt. agg.) 1/8 in.	(Sand agg.) 1/8 in.	1/2 in.	3/4 in.		(lt. wt. agg.) 1/2 in.	(Sand agg.) 1/4 in.	(lt. wt. agg.) 1/2 in.	(Sand agg.) 1/4 in.	On furring or channels		On gypsum bd. (5/8 in.)					
Material	R	avg R	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U			
Concrete ^c (sand agg.) (4 in.) 0.32 (6 in.) 0.48	0.40	None.....	—	0.62	0.59	0.61	0.36	0.29	0.36	0.32	0.35	0.34	0.38	0.27	0.24	0.25	0.22	1		
		Floor tile ^d or linoleum (3/8 in.).....	0.06	0.60	0.57	0.59	0.35	0.29	0.35	0.32	0.34	0.33	0.38	0.27	0.23	0.25	0.22	2		
		Wood block (1 3/16 in.) on slab.....	0.74	0.42	0.41	0.42	0.28	0.24	0.28	0.26	0.28	0.27	0.30	0.23	0.20	0.21	0.19	3		
		Floor on sleepers Plywood subfloor (5/8 in.), felt and floor tile ^a or linoleum (3/8 in.).....	0.89	0.30	0.29	0.30	0.22	0.19	0.22	0.21	0.22	0.21	0.23	0.19	0.17	0.17	0.16	4		
		Wood subfloor (2 5/32 in.), felt and hardwood (3/4 in.).....	1.72	0.24	0.24	0.24	0.19	0.17	0.19	0.18	0.18	0.18	0.19	0.16	0.15	0.15	0.14	5		
Concrete ^c (sand agg.) (8 in.) 0.64 (10 in.) 0.80	0.72	None.....	—	0.52	0.50	0.51	0.32	0.27	0.32	0.29	0.31	0.31	0.34	0.25	0.22	0.23	0.20	6		
		Floor tile ^d or linoleum (3/8 in.).....	0.06	0.50	0.48	0.50	0.31	0.26	0.32	0.29	0.31	0.30	0.34	0.25	0.22	0.23	0.20	7		
		Wood block (1 3/16 in.) on slab.....	0.74	0.37	0.36	0.37	0.26	0.22	0.26	0.24	0.25	0.25	0.27	0.21	0.19	0.20	0.18	8		
		Floor on sleepers Plywood subfloor (5/8 in.), felt and floor tile ^a or linoleum (3/8 in.).....	0.89	0.27	0.27	0.27	0.21	0.18	0.21	0.19	0.20	0.20	0.21	0.17	0.16	0.17	0.15	9		
		Wood subfloor (2 5/32 in.), felt and hardwood (3/4 in.).....	1.72	0.22	0.22	0.22	0.18	0.16	0.18	0.17	0.17	0.17	0.18	0.16	0.14	0.15	0.13	10		

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

^b Table E-12 can be used only if sleeper space is non-reflective. The sleeper air space is not to be counted in using Table E-12.

^c Concrete is assumed to have a thermal conductivity k of 12.0.

^d Includes asphalt, rubber, and plastic tile (1/8 in.), ceramic tile on terrazzo (1 in.).

Table E-8. Coefficients of Transmission (U) of Concrete Floor-Ceiling Constructions—Continued

B Summer conditions, downward flow

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on still air (no wind) conditions on both sides

Example—Floor X 2		Example of Substitution	
Construction (heat flow down)	Resistance (R)	Replace item 2 with wood subfloor (3/8 in.), felt and hardwood (1/2 in.) (floor on sleepers)	
1. Top surface (still air)	0.92	Total resistance	3.41
2. Linoleum or tile (avg R)	0.05	Deduct 2. Linoleum or tile	0.05
3. Concrete slab 4 in. (avg R)	0.40	Difference	3.36
4. Air space ^a (8 in.)	0.99	Add 2. Hardwood (1/2 in.)	0.88
5. Metal lath and 1/2 in. plas. (sand agg.)	0.13	2a. Felt	0.06
6. Bottom surface (still air)	0.92	2b. Wood subfloor (3/8 in.)	0.98
		2c. Air space (1/2 in.)	0.85
Total resistance	3.41	Total resistance	5.93
U = 1/R = 1/3.41 =	0.29	U = 1/R = 1/5.93 =	0.17
See value 0.29 in boldface type in table below.			

To Adjust U Values for Construction with Added Insulation in Air Space above Suspended Ceiling, See Table E-12.

Type of Deck	Type of Finish Floor	Type of Ceiling																Number							
		Resistance ↓ →	Ceiling Applied Directly to Slab				Suspended Ceiling																		
			Plas.		Acoustical tile—glued		Gypsum bd. (3/8 in.) and Plas.		Metal lath and plas.		Acoustical tile														
			(Lt. wt. agg.) 1/8 in.	(Sand agg.) 1/2 in.	1/2 in.	3/4 in.	No plas.	(Lt. wt. agg.) 1/2 in.	(Sand agg.) 1/2 in.	(Lt. wt. agg.) 3/4 in.	(Sand agg.) 3/4 in.	On furring or channels		On gypsum bd. (3/8 in.)											
Material	R	avg R	None	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U			
			O	P	Q	R	S	T	U	V	W	X	Y	Z	Z'	Z''									
Concrete ^c (sand agg.) (4 in.) 0.32 (6 in.) 0.43	None	—	0.45	0.43	0.44	0.29	0.25	0.28	0.26	0.27	0.27	0.30	0.23	0.20	0.21	0.19								1	
	Floor tile ^d or linoleum (1/2 in.)	0.05	0.44	0.42	0.43	0.29	0.25	0.28	0.26	0.27	0.27	0.29	0.22	0.20	0.21	0.19								2	
	Wood block (13/16 in.) on slab	0.74	0.34	0.33	0.33	0.24	0.21	0.23	0.22	0.23	0.23	0.24	0.19	0.17	0.18	0.17								3	
	Floor on sleepers Plywood subfloor (5/8 in.), felt and floor tile ^d or linoleum (1/2 in.)	0.89	0.23	0.23	0.23	0.18	0.17	0.19	0.18	0.19	0.18	0.20	0.16	0.15	0.15	0.14									4
	Wood subfloor (13/32 in.), felt and hardwood (3/4 in.)	1.72	0.20	0.19	0.20	0.16	0.15	0.16	0.15	0.16	0.16	0.17	0.14	0.13	0.14	0.13									5
Concrete ^c (sand agg.) (8 in.) 0.64 (10 in.) 0.80	None	—	0.39	0.38	0.39	0.27	0.23	0.26	0.24	0.25	0.25	0.27	0.21	0.19	0.20	0.18								6	
	Floor tile ^d or linoleum (1/2 in.)	0.05	0.38	0.37	0.38	0.26	0.23	0.26	0.24	0.25	0.25	0.27	0.21	0.19	0.20	0.18								7	
	Wood block (13/16 in.) on slab	0.74	0.30	0.30	0.30	0.22	0.20	0.22	0.20	0.21	0.21	0.23	0.18	0.16	0.17	0.16								8	
	Floor on sleepers Plywood subfloor (5/8 in.), felt and floor tile ^d or linoleum (1/2 in.)	0.89	0.22	0.21	0.22	0.17	0.16	0.18	0.17	0.18	0.17	0.18	0.15	0.14	0.15	0.14									9
	Wood subfloor (13/32 in.), felt and hardwood (3/4 in.)	1.72	0.19	0.18	0.18	0.15	0.14	0.16	0.15	0.15	0.15	0.16	0.14	0.13	0.13	0.12									10

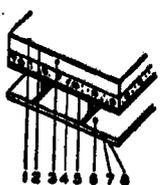
^{a, c, d} See corresponding footnotes under A, Table E-8.

Table E-9. Coefficients of Transmission (U) of Flat Masonry Roofs with Built-up Roofing, with and without Suspended Ceilings

A Winter condition, upward flow

without Suspended Ceilings (Winter Conditions, Upward Flow)

These Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph



Construction (heat flow up)	Resistance (R)
1. Outside surface (15 mph wind).....	0.17
2. Built-up roofing— $\frac{3}{8}$ in.....	0.53
3. Roof insulation (none).....	
4. Concrete slab (lt. wt. agg.) (2 in.).....	2.22
5. Corrugated metal.....	0
6. Air space ^a	0.65
7. Metal lath and $\frac{3}{8}$ in. plas. (lt. wt. agg.).....	0.47
8. Inside surface (still air).....	0.61

Total resistance..... 4.65
 $U = 1/R = 1/4.65 =$ 0.22
 See value 0.22 in boldface type in table below.

Example of Substitution

Replace item 4 with 4 in. concrete slab (gravel agg.) and roof insulation (C = 0.36) on top of slab.	
Total resistance.....	4.65
Deduct	
4. Concrete slab (lt. wt. agg.) (2 in.).....	2.22
Difference.....	2.43
Add 3. Roof insulation (C = 0.36).....	2.78
4. Concrete slab (gravel agg.) 4 in.....	0.44
Total resistance.....	5.65
$U = 1/R = 1/5.65 =$	0.18

To Adjust U Values for Construction with Added Insulation in Air Space, See Table E-12.

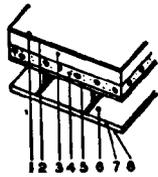
Type of Deck	Type of Form	Type of Ceiling																Number		
		Roof Insulation No Ceiling							Suspended Ceiling ^d											
		C value of roof insulation							Gypsum bd. ($\frac{3}{8}$ in.) and plas.			Metal lath and plas.			Acoustical tile					
		None	0.72	0.36	0.24	0.19	0.15	0.12	No plas.	Li. wt. agg. $\frac{1}{2}$ in.	Sand agg. $\frac{1}{2}$ in.	Li. wt. agg. $\frac{3}{8}$ in.	Sand agg. $\frac{3}{8}$ in.	On furring or channels $\frac{1}{2}$ in.	On gypsum bd. ($\frac{3}{8}$ in.) $\frac{3}{4}$ in.	$\frac{1}{2}$ in.	$\frac{3}{4}$ in.			
Material	R	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U			
Concrete slab ^e Gravel agg. (4 in.).. 0.38 (6 in.).. 0.48 (8 in.).. 0.64 Lt. wt. agg. ^d (3 in.).. 2.22	Temporary.....	0.70	0.35	0.24	0.18	0.15	0.12	0.10	0.38	0.34	0.37	0.36	0.41	0.29	0.25	0.26	0.23	1		
	Temporary.....	0.63	0.34	0.23	0.17	0.15	0.12	0.10	0.36	0.32	0.35	0.34	0.39	0.24	0.25	0.22	2	2		
	Temporary.....	0.57	0.32	0.22	0.17	0.14	0.12	0.10	0.34	0.31	0.33	0.33	0.37	0.26	0.23	0.24	0.21	3		
	Corrugated metal ^b	0	0.30	0.21	0.16	0.13	0.12	0.10	0.09	0.22	0.21	0.22	0.23	0.19	0.17	0.18	0.16	4		
	Insulation bd. (1 in.).....	2.78	0.16	0.13	0.11	0.10	0.09	0.08	0.07	0.14	0.13	0.14	0.13	0.12	0.11	0.12	0.11	5		
	Insulation bd. ($\frac{1\frac{1}{2}$ in.).....	4.17	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.12	0.11	0.12	0.11	0.10	0.10	0.10	0.10	6		
	Glass fiber bd. (1 in.).....	4.00	0.14	0.11	0.10	0.09	0.08	0.07	0.06	0.12	0.11	0.12	0.12	0.11	0.10	0.10	0.10	7		
	Corrugated metal ^b	0	0.23	0.17	0.14	0.12	0.10	0.09	0.08	0.18	0.17	0.18	0.17	0.18	0.15	0.14	0.15	8		
	Insulation bd. (1 in.).....	2.78	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.12	0.11	0.12	0.12	0.11	0.10	0.10	0.10	9		
	Insulation bd. ($\frac{1\frac{1}{2}$ in.).....	4.17	0.12	0.10	0.09	0.08	0.07	0.07	0.06	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	10		
(3 in.).. 3.33	Glass fiber bd. (1 in.).....	4.00	0.12	0.10	0.09	0.08	0.07	0.07	0.06	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	10		
	Corrugated metal ^b	0	0.18	0.14	0.12	0.10	0.09	0.08	0.07	0.15	0.14	0.15	0.15	0.13	0.12	0.13	0.12	12		
	Insulation bd. (1 in.).....	2.78	0.12	0.10	0.09	0.08	0.07	0.07	0.06	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.09	13		
	Insulation bd. ($\frac{1\frac{1}{2}$ in.).....	4.17	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	14		
	Glass fiber bd. (1 in.).....	4.00	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	15		
	(4 in.).. 4.44	Corrugated metal ^b	0	0.18	0.14	0.12	0.10	0.09	0.08	0.07	0.15	0.14	0.15	0.15	0.13	0.12	0.13	0.12	12	
		Insulation bd. (1 in.).....	2.78	0.12	0.10	0.09	0.08	0.07	0.07	0.06	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.09	13	
		Insulation bd. ($\frac{1\frac{1}{2}$ in.).....	4.17	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	14	
		Glass fiber bd. (1 in.).....	4.00	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	15	
		Gypsum slab ^f (2 in.).. 1.20	Gypsum bd. ($\frac{3}{8}$ in.).....	0.45	0.36	0.24	0.18	0.14	0.12	0.11	0.09	0.25	0.24	0.25	0.27	0.21	0.19	0.20	0.18	16
Insulation bd. (1 in.).....			2.78	0.20	0.15	0.13	0.11	0.10	0.09	0.07	0.16	0.15	0.16	0.16	0.14	0.13	0.13	0.12	17	
Insulation bd. ($\frac{1\frac{1}{2}$ in.).....			4.17	0.18	0.13	0.11	0.09	0.08	0.08	0.07	0.13	0.13	0.13	0.13	0.12	0.11	0.11	0.11	18	
Asbestos-cement bd. ^c ($\frac{3}{4}$ in.).....			0.06	0.40	0.28	0.19	0.15	0.13	0.11	0.09	0.27	0.25	0.26	0.26	0.29	0.22	0.19	0.20	0.18	19
Glass fiber bd. (1 in.).....			4.00	0.16	0.13	0.11	0.10	0.09	0.08	0.07	0.13	0.13	0.13	0.14	0.12	0.11	0.12	0.11	20	
(3 in.).. 1.80			Gypsum bd. ($\frac{3}{8}$ in.).....	0.45	0.30	0.21	0.16	0.13	0.12	0.10	0.09	0.22	0.21	0.22	0.21	0.23	0.19	0.17	0.16	21
	Insulation bd. (1 in.).....		2.78	0.18	0.14	0.12	0.10	0.09	0.08	0.07	0.15	0.14	0.14	0.14	0.13	0.12	0.12	0.12	22	
	Insulation bd. ($\frac{1\frac{1}{2}$ in.).....		4.17	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.12	0.12	0.12	0.12	0.11	0.10	0.11	0.10	23	
	Asbestos-cement bd. ($\frac{3}{4}$ in.).....		0.06	0.34	0.23	0.17	0.14	0.12	0.10	0.09	0.24	0.22	0.24	0.23	0.25	0.20	0.18	0.19	0.17	24
	Glass fiber bd. (1 in.).....		4.00	0.14	0.12	0.10	0.09	0.08	0.07	0.07	0.12	0.12	0.12	0.12	0.11	0.10	0.11	0.10	25	
	(4 in.).. 2.40	Gypsum bd. ($\frac{3}{8}$ in.).....	0.45	0.28	0.19	0.15	0.12	0.11	0.09	0.08	0.19	0.18	0.19	0.19	0.20	0.17	0.15	0.16	26	
		Insulation bd. (1 in.).....	2.78	0.16	0.13	0.11	0.10	0.09	0.08	0.07	0.13	0.13	0.13	0.13	0.14	0.12	0.11	0.12	27	
		Insulation bd. ($\frac{1\frac{1}{2}$ in.).....	4.17	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.12	0.10	0.10	0.09	28	
		Asbestos-cement bd. ($\frac{3}{4}$ in.).....	0.06	0.28	0.20	0.15	0.13	0.11	0.10	0.08	0.21	0.20	0.21	0.20	0.22	0.18	0.16	0.17	29	
		Glass fiber bd. (1 in.).....	4.00	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.12	0.11	0.11	0.11	0.12	0.10	0.10	0.10	30	

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.
^b U values would also apply if slab were poured on metal lath, paper-backed wire, fabric, or asbestos-cement board ($\frac{1}{2}$ in.).
^c Concrete assumed to have a thermal conductivity k of 12.0 and a density of 140 lb per cu ft.
^d Concrete assumed to have a thermal conductivity k of 0.90 and a density of 30 lb per cu ft.
^e Gypsum slab 2 $\frac{1}{2}$ in. thick since this is recommended practice.
^f Gypsum fiber concrete with 12 $\frac{1}{2}$ percent wood chips (thermal conductivity k = 1.66).
^g See Table E-12 for U value of roof and ceiling construction with roof insulation added to roof deck.

Table E-9. Coefficients of Transmission (U) of Flat Masonry Roofs with Built-up Roofing with and without Suspended Ceiling—Continued

R Summer conditions, downward flow

These coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 7.5 mph



Example—Roof 1' 2	
Construction (heat flow down)	Resistance (R)
1. Outside surface (7.5 mph wind)	0.25
2. Built-up roofing (3/8 in.)	0.33
3. Roof insulation (none)	0.00
4. Concrete slab (gravel agg.) (6 in.)	0.48
5. Temporary form bd.	0.00
6. Air space ^a (8 in.)	0.99
7. Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.)	0.64
8. Inside surface (still air)	0.92
Total resistance	3.61
$U = 1/R = 1/3.61 =$	0.28

See value 0.28 in boldface type in table below.

Example of Substitution	
Replace item 3 with roof insulation (C=0.36) and remove suspended ceiling	
Total resistance	3.61
Deduct 6. Air space	0.99
7. Gypsum lath (3/8 in.) and 1/2 in. plas. (lt. wt. agg.)	0.64
Total resistance	1.63
Difference	1.98
Add 3. Roof insulation (C=0.36)	2.78
Total resistance	4.78
$U = 1/R = 1/4.78 =$	0.21

To Adjust U Values for Construction with Added Insulation in Air Space, See Table E-12.

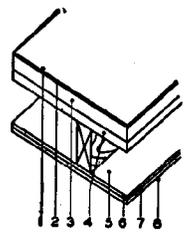
Type of Deck	Type of Form	Type of Ceiling																Number	
		Roof Insulation—No Ceiling						Suspended Ceiling ⁸				Acoustical tile							
		C value of roof insulation						Gypsum bd. (3/8 in.) and plas.		Metal lath and plas.		On furring or channels							
		None	0.72	0.36	0.24	0.19	0.15	0.12	No plas.	Lt. wt. agg. (3/8 in.)	Sand agg. (3/8 in.)	Lt. wt. agg. (3/8 in.)	Sand agg. (3/8 in.)	1/2 in.	3/4 in.	1/2 in.	3/4 in.		
			1.39	2.78	4.17	5.26	6.67	8.33	0.32	0.64	0.41	0.47	0.13	1.79	1.78	1.51	2.10		
			U	U	U	U	U	U	U	U	U	U	U	U	U	U	U		
			A'	B'	C'	D'	E'	F'	G'	H'	I'	J'	K'	L'	M'	N'	O'	P'	
Concrete slab ^c (Gravel agg.) (4 in.) . . . 0.32 (6 in.) . . . 0.48 (8 in.) . . . 0.64 Lt wt. agg. ^d (2 in.) . . . 2.22 (3 in.) . . . 3.33 (4 in.) . . . 4.44	Temporary Temporary Temporary Corrugated metal ^b Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Glass fiber bd. (1 in.) Corrugated metal ^b Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Glass fiber bd. (1 in.) Corrugated metal ^b Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Glass fiber bd. (1 in.)	—	0.55	0.31	0.22	0.17	0.14	0.12	0.10	0.32	0.29	0.31	0.30	0.34	0.25	0.22	0.23	0.20	1
		—	0.51	0.30	0.21	0.16	0.14	0.12	0.10	0.30	0.28	0.30	0.29	0.32	0.24	0.21	0.22	0.20	2
		—	0.47	0.28	0.20	0.16	0.14	0.11	0.10	0.29	0.27	0.28	0.28	0.31	0.23	0.20	0.22	0.19	3
		0	0.27	0.20	0.15	0.13	0.11	0.10	0.08	0.20	0.19	0.20	0.19	0.21	0.17	0.15	0.16	0.15	4
		2.78	0.15	0.13	0.11	0.09	0.09	0.08	0.07	0.13	0.12	0.13	0.13	0.13	0.12	0.11	0.11	0.10	5
		4.17	0.13	0.11	0.09	0.08	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.11	0.10	0.09	0.10	0.09	6
		4.00	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.09	7
		0	0.21	0.16	0.13	0.11	0.10	0.09	0.08	0.16	0.16	0.16	0.16	0.17	0.14	0.13	0.14	0.13	8
		2.78	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.09	9
		4.17	0.11	0.10	0.08	0.08	0.07	0.06	0.06	0.10	0.09	0.10	0.10	0.10	0.09	0.09	0.09	0.08	10
		4.00	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.08	11
		0	0.17	0.14	0.11	0.10	0.09	0.08	0.07	0.14	0.13	0.14	0.14	0.14	0.12	0.12	0.12	0.11	12
2.78	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.08	13		
4.17	0.10	0.09	0.08	0.07	0.07	0.06	0.05	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	14		
4.00	0.10	0.09	0.08	0.07	0.07	0.06	0.05	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	15		
Gypsum slab ^f (2 in.) . . . 1.80 (3 in.) . . . 1.80 (4 in.) . . . 2.40	Gypsum bd. (1/2 in.) Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Asbestos-cement bd. ^e 1/4 in.) Glass fiber bd. (1 in.) Gypsum bd. (1/2 in.) Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Asbestos-cement bd. 1/4 in.) Glass fiber bd. (1 in.) Gypsum bd. (1/2 in.) Insulation bd. (1 in.) Insulation bd. (1 1/2 in.) Asbestos-cement bd. 1/4 in.) Glass fiber bd. (1 in.)	0.45	0.32	0.22	0.17	0.14	0.12	0.10	0.09	0.22	0.21	0.22	0.22	0.23	0.19	0.17	0.18	0.16	16
		2.78	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.15	0.14	0.15	0.14	0.15	0.13	0.12	0.13	0.12	17
		4.17	0.15	0.12	0.10	0.09	0.08	0.07	0.07	0.12	0.12	0.12	0.12	0.13	0.11	0.10	0.11	0.10	18
		0.08	0.34	0.23	0.18	0.14	0.12	0.10	0.09	0.25	0.23	0.24	0.24	0.26	0.20	0.18	0.19	0.17	19
		4.00	0.15	0.12	0.11	0.09	0.08	0.07	0.07	0.13	0.12	0.12	0.12	0.13	0.11	0.11	0.11	0.10	20
		0.45	0.27	0.19	0.15	0.13	0.11	0.10	0.08	0.20	0.19	0.19	0.19	0.21	0.17	0.15	0.16	0.15	21
		2.78	0.16	0.13	0.11	0.10	0.09	0.08	0.07	0.14	0.13	0.13	0.13	0.14	0.12	0.11	0.12	0.11	22
		4.17	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.12	0.10	0.11	0.10	0.10	23
		0.06	0.30	0.21	0.16	0.13	0.12	0.10	0.09	0.2	0.20	0.21	0.21	0.22	0.18	0.16	0.17	0.16	24
		4.00	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.12	0.11	0.12	0.11	0.12	0.11	0.10	0.10	0.10	25
		0.45	0.23	0.17	0.14	0.12	0.10	0.09	0.08	0.18	0.17	0.17	0.17	0.18	0.15	0.14	0.15	0.13	26
		2.78	0.15	0.12	0.11	0.09	0.08	0.07	0.07	0.13	0.12	0.12	0.12	0.13	0.11	0.11	0.11	0.10	27
4.17	0.12	0.11	0.09	0.08	0.08	0.07	0.06	0.11	0.10	0.11	0.11	0.11	0.10	0.09	0.10	0.09	28		
0.06	0.25	0.19	0.15	0.12	0.11	0.09	0.08	0.19	0.18	0.19	0.19	0.20	0.16	0.15	0.16	0.14	29		
4.00	0.13	0.11	0.09	0.08	0.08	0.07	0.06	0.11	0.11	0.11	0.11	0.11	0.10	0.09	0.10	0.09	30		

a, b, d, e, f. See corresponding footnotes under A, Table E-9.

Table E-10. Coefficients of Transmission (U) of Wood or Metal Construction Flat Roofs and Ceilings

A Winter condition, upward flow

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based upon an outside wind velocity of 15 mph



Construction (Heat flow up)	Resistance (R)
1. Outside surface (15 mph wind)	0.17
2. Built-up roofing $\frac{3}{8}$ in.	0.33
3. Roof insulation ($C = 0.72$)	1.39
4. Wood deck (1 in.)	0.98
5. Air space ^a	0.86
6. Gypsum wall board ($\frac{3}{8}$ in.)	0.32
7. Acoustical tile ($\frac{1}{2}$ in.)—glued	1.19
8. Inside surface (still air)	0.61
Total resistance	5.84
$U = 1/R = 1/5.84$	0.17

See value 0.17 in boldface type in table below.

Example of Substitution	
Replace item 4 with 2 in. wood deck (exposed to inside) and omit items 5, 6, and 7.	
Total resistance	5.84
Deduct 4. Wood deck (1 in.)	0.98
5. Air space	0.86
6. Gypsum wall board ($\frac{3}{8}$ in.)	0.32
7. Acoustical tile ($\frac{1}{2}$ in.) glued	1.19
Total resistance	4.63
Difference	2.60
Add 4. Wood deck (2 in.)	2.03
Total resistance	4.63
$U = 1/R = 1/4.63 =$	0.22

To Adjust U Values for Construction with Added Insulation in Air Space, See Table E-12.

Type of Deck (Built-up Roof in All Cases)		Insulation Added on Top of Deck ^c		Type of Ceiling											Number				
				Gypsum Bd. ($\frac{3}{8}$ in. and Plas.)				Metal Lath and Plas.		Insul. Bd. ($\frac{1}{2}$ in.)	Acoustical Tile								
				None	None	Lt. wt. agg. $\frac{1}{2}$ in.	Sand agg. $\frac{1}{2}$ in.	Lt. wt. agg. $\frac{1}{4}$ in.	Sand agg. $\frac{1}{4}$ in.		Plain (1.43) or $\frac{1}{2}$ in. plas. sand agg. (1.52)	On Furring		On Gypsum Bd. ($\frac{1}{2}$ in.)					
										Resistance		Resistance	U	U		U	U	U	U
Material	R	C	R	U	U	U	U	U	U	U	U	U	U	U	U	U	U		
Wood ^b 1 in.	0.98	None	—	0.48	0.31	0.28	0.30	0.29	0.33	0.23	0.24	0.18	0.17	0.18	0.16	0.16	0.16	1	
		0.72	1.39	0.29	0.22	0.20	0.21	0.21	0.22	0.17	0.18	0.15	0.14	0.15	0.13	0.16	0.16	2	
		0.36	2.78	0.21	0.17	0.16	0.16	0.16	0.17	0.14	0.14	0.13	0.12	0.12	0.11	0.13	0.13	3	
		0.24	4.17	0.16	0.13	0.13	0.13	0.13	0.14	0.12	0.12	0.10	0.11	0.10	0.10	0.11	0.11	4	
		0.19	5.28	0.14	0.12	0.11	0.12	0.12	0.12	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.10	5
		0.15	6.67	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	6
		0.12	8.33	0.10	0.09	0.08	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	7
Wood ^b 2 in.	2.03	None	—	0.32	0.23	0.22	0.23	0.22	0.24	0.18	0.19	0.15	0.14	0.15	0.13	0.13	0.13	8	
		0.72	1.39	0.22	0.18	0.17	0.17	0.17	0.18	0.15	0.16	0.13	0.12	0.12	0.11	0.11	0.11	9	
		0.36	2.78	0.17	0.14	0.13	0.14	0.14	0.14	0.12	0.12	0.10	0.10	0.10	0.10	0.10	0.10	10	
		0.24	4.17	0.14	0.12	0.11	0.12	0.12	0.12	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.10	11	
		0.19	5.28	0.12	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	12	
		0.15	6.67	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	13
		0.12	8.33	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	14
Wood ^b 3 in.	3.28	None	—	0.23	0.18	0.17	0.18	0.18	0.19	0.15	0.16	0.13	0.12	0.12	0.11	0.11	0.11	15	
		0.72	1.39	0.17	0.14	0.14	0.14	0.14	0.15	0.12	0.13	0.10	0.10	0.10	0.10	0.10	0.10	16	
		0.36	2.78	0.14	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.09	0.09	0.09	0.09	0.09	0.09	17	
		0.24	4.17	0.12	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	18	
		0.19	5.28	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.08	19	
		0.15	6.67	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	20	
		0.12	8.33	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	21
Preformed slabs—wood fiber and cement binder	2 in.	3.60	None	—	0.21	0.17	0.16	0.17	0.18	0.14	0.15	0.11	0.11	0.14	0.13	0.13	22		
	3 in.	5.40	None	—	0.15	0.13	0.13	0.13	0.13	0.11	0.12	0.11	0.11	0.11	0.11	0.11	23		
Flat metal roof deck	0	None	—	0.90	0.44	0.38	0.42	0.41	0.48	0.29	0.32	0.27	0.29	0.25	0.25	0.25	0.25	24	
		0.72	1.39	0.40	0.27	0.25	0.27	0.26	0.29	0.21	0.22	0.19	0.21	0.18	0.18	0.18	0.18	25	
		0.36	2.78	0.26	0.20	0.19	0.19	0.19	0.21	0.16	0.17	0.15	0.16	0.15	0.15	0.15	0.15	26	
		0.24	4.17	0.19	0.16	0.15	0.15	0.15	0.16	0.13	0.14	0.13	0.13	0.12	0.12	0.12	0.12	27	
		0.19	5.28	0.16	0.13	0.13	0.13	0.13	0.14	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	28	
		0.15	6.67	0.13	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	29	
		0.12	8.33	0.11	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	30

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.

^b Wood deck 1, 2, and 3 in. is assumed to be $\frac{3}{4}$, 1, and 2 in. thick, respectively. The thermal conductivity k is assumed to be 0.80.

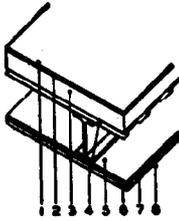
^c If a vapor barrier is used beneath roof insulation it will have a negligible effect on the U value.

Table E-10. Coefficients of Transmission (U) of Wood or Metal Construction Flat Roofs and Ceilings—Continued

B Summer conditions, downward flow

Construction Flat Roofs and Ceilings (Summer Conditions, Downward Flow)

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based upon an outside wind velocity of 7.5 mph



Example—Roof F' 27

Construction	Resistance (R)
1. Outside surface (7.5 mph wind)	0.25
2. Built-up roofing (3/8 in.)	0.33
3. Roof insulation (C=0.24) ^a	4.17
4. Metal deck	0.00
5. Air space ^b	0.99
6. Metal lath and	0.13
7. 3/4 in. plas. (sand agg.)	
8. Inside surface (still air)	0.92
Total resistance	6.79
$U = 1/R = 1/6.79$	0.15

See value 0.15 in boldface type in table below.

Example of Substitution

Replace item 3 with roof insulation (C=0.36) and items 6 and 7 with metal lath and 3/4 in. plas. (lt. wt. agg.)		0.79
Total resistance		6.79
Deduct 3. Roof insulation (C=0.24)	4.17	
6. Metal lath and 7. 3/4 in. plas. (sand agg.)	0.13	4.30
Difference		2.49
Add 3. Roof insulation (C=0.36)	2.78	
6. Metal lath and 7. 3/4 in. plas. (lt. wt. agg.)	0.47	3.25
Total resistance		5.74
$U = 1/R = 1/5.74$		0.17

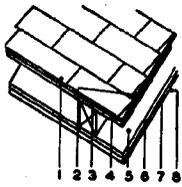
To Adjust U Values for Construction with Added Insulation in Air Space See Table E-12.

Type of Deck (Built-up Roof in All Cases)	Resistance	Insulation Added on Top of Deck ^c		Type of Ceiling											Number		
		Conductance of Insul.	Resistance	None	Gypsum Bd. (3/8 in.) and Plas.			Metal Lath and Plas.		Insul. Bd. (1/2 in.) Plain (1.43) or 1/2 in. plas. sand agg. 1.52	Acoustical Tile						
					None	Lt. wt. agg. 1/2 in.	Sand agg. 1/2 in.	Lt. wt. agg. 3/4 in.	Sand agg. 3/4 in.		On Furring		On Gypsum Bd. (1/2 in.)				
											1/2 in.	3/4 in.	1/2 in.	3/4 in.			
Material	R	C	R	U	U	U	U	U	U	U	U	U	U	U	U		
Wood ^b 1 in.	0.98	None	—	0.40	0.26	0.24	0.26	0.25	0.28	0.20	0.22	0.17	0.18	0.16	0.15	0.14	1
		0.72	1.39	0.26	0.19	0.18	0.19	0.19	0.20	0.16	0.17	0.15	0.16	0.14	0.14	0.12	2
		0.36	2.78	0.19	0.15	0.15	0.15	0.15	0.16	0.13	0.13	0.11	0.11	0.11	0.10	0.10	3
		0.24	4.17	0.15	0.13	0.12	0.12	0.12	0.13	0.11	0.11	0.10	0.11	0.11	0.11	0.10	4
		0.19	5.88	0.13	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.08	5
		0.15	6.87	0.11	0.10	0.09	0.10	0.09	0.10	0.09	0.09	0.10	0.09	0.08	0.08	0.08	6
		0.12	8.33	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	7
Wood ^b 2 in.	2.03	None	—	0.28	0.21	0.19	0.20	0.20	0.22	0.17	0.17	0.17	0.18	0.16	0.15	0.15	8
		0.72	1.39	0.20	0.16	0.15	0.16	0.16	0.17	0.14	0.14	0.13	0.14	0.13	0.13	0.12	9
		0.36	2.78	0.16	0.13	0.13	0.13	0.13	0.13	0.11	0.11	0.10	0.11	0.11	0.11	0.11	10
		0.24	4.17	0.13	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.10	0.10	0.10	0.09	11
		0.19	5.88	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	12
		0.15	6.87	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	13
		0.12	8.33	0.08	0.08	0.07	0.07	0.07	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	14
Wood ^b 3 in.	3.23	None	—	0.21	0.17	0.16	0.16	0.16	0.17	0.14	0.14	0.15	0.13	0.14	0.13	0.13	15
		0.72	1.39	0.16	0.13	0.13	0.13	0.13	0.14	0.12	0.12	0.11	0.12	0.11	0.11	0.11	16
		0.36	2.78	0.13	0.11	0.11	0.11	0.11	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.09	17
		0.24	4.17	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.08	18
		0.19	5.88	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	19
		0.15	6.87	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	20
		0.12	8.33	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	21
Preformed slabs—wood fiber and cement binder	3.60	None	—	0.20	0.16	0.15	0.15	0.15	0.16	0.13	0.13	0.14	0.15	0.13	0.12	0.12	22
		None	—	0.14	0.12	0.12	0.12	0.12	0.13	0.11	0.11	0.11	0.12	0.11	0.10	0.10	23
Flat Metal Roof Deck	0	None	—	0.67	0.36	0.32	0.34	0.34	0.38	0.25	0.25	0.27	0.23	0.25	0.22	0.22	24
		0.72	1.39	0.35	0.24	0.22	0.23	0.23	0.25	0.19	0.19	0.20	0.18	0.19	0.17	0.17	25
		0.36	2.78	0.23	0.18	0.17	0.18	0.17	0.19	0.15	0.15	0.16	0.14	0.15	0.14	0.14	26
		0.24	4.17	0.18	0.14	0.14	0.14	0.14	0.15	0.12	0.12	0.13	0.12	0.12	0.11	0.11	27
		0.19	5.88	0.15	0.12	0.12	0.12	0.12	0.13	0.11	0.11	0.11	0.11	0.11	0.10	0.10	28
		0.15	6.87	0.12	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.10	0.09	0.09	0.09	0.09	29
		0.12	8.33	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	30

^a To adjust U values for the effect of added insulation between framing members, see Table E-12.
^b Wood deck 1, 2, and 3 in. is assumed to be 3/8, 1/2, and 3/4 in. thick, respectively. The thermal conductivity k is assumed to be 0.80.
^c If a vapor barrier is used beneath roof insulation it will have a negligible effect on the U value.

Table E-11. Coefficients of Transmission (U) of Pitched Roofs

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph for heat flow upward and 7.5 mph for heat flow downward



Example—Roof C 4		Example of Substitution	
Construction (Heat flow up)	Resistance (R)		
1. Outside surface (15 mph wind)	0.17	Find U value for same construction with heat flow down (summer conditions)	
2. Slate shingles (3/8 in.)	0.05	Total resistance	
3. Building paper	0.06	Deduct 1. Outside surface (15 mph wind)	
4. Wood sheathing (25/32 in.)	0.98	5. Air space	
5. Air space ^b	0.90	8. Inside surface (still air)	
6. Gypsum lath (3/8 in.)	0.32	Difference	
7. Plas. (sand agg.) (1/2 in.)	0.09	Add 1. Outside surface (7.5 mph wind)	
8. Inside surface (still air)	0.52	5. Air space	
Total resistance	3.19	8. Inside surface (still air)	
$U = 1/R = 1/3.19$	0.31	Total resistance	
See value 0.31 in boldface type in table below.		$U = 1/R = 1/3.40$	

To Adjust U Values for Construction with Added Insulation between Framing Members, See Table E-12.

Direction of Heat Flow →	Upward Flow Winter Conditions						Downward Flow Summer Conditions					Number
	Rafter Space						Rafter Space					
	Unventilated, Not to be Further Insulated					Insulated	Unventilated, Not to be Further Insulated				Insulated	
	Asphalt shingles building paper		Asbestos-cement slate or tile shingles, building paper on wood sheathing (25/32 in.)	Wood shingles on 1 x 4 in. wood strips on 6-in. centers			Asphalt shingles building paper		Asbestos-cement slate, or the shingles, building paper on wood sheathing (25/32 in.)	Wood shingles on 1 x 4 in. wood strips on 6 in. centers		
On plywood sheathing (5/16 in.)	On wood sheathing (25/32 in.)	U		U	U	U	U	U		U	U	
Resistance	0.95	1.48	1.09	0.87	—	0.95	1.48	1.09	0.87	—		
Material	R	U	U	U	U	U	U	U	U	U		
		A	B	C	D	E	F	G	H	I	J	
None	—	0.57	0.44	0.53	0.60	0.66	0.51	0.40	0.48	0.53	0.56	1
Gypsum bd. (3/8 in.)	0.32	0.34	0.29	0.32	0.35	0.54	0.30	0.26	0.29	0.31	0.47	2
Gypsum lath (3/8 in.) & 1/2 in. plas. (lt. wt. agg.)	0.64	0.30	0.26	0.29	0.31	0.46	0.28	0.24	0.27	0.28	0.41	3
Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.)	0.41	0.33	0.28	0.31	0.34	0.52	0.29	0.25	0.28	0.30	0.45	4
Metal lath and 3/4 in. plas. (lt. wt. agg.)	0.47	0.32	0.27	0.31	0.33	0.50	0.29	0.25	0.28	0.30	0.44	5
Metal lath and 3/4 in. plas. (sand agg.)	0.15	0.36	0.30	0.34	0.37	0.61	0.32	0.27	0.31	0.33	0.52	6
Insul. bd. (1/2 in.)	1.43	0.25	0.22	0.24	0.25	0.34	0.23	0.20	0.22	0.23	0.31	7
Insul. bd. lath and 1/2 in. plas. (sand agg.)	1.52	0.24	0.21	0.23	0.25	0.33	0.22	0.20	0.22	0.23	0.30	8
Acoustical tile												
(1/2 in.) on gypsum bd. (3/8 in.)	1.51	0.24	0.21	0.23	0.25	0.33	0.22	0.20	0.22	0.23	0.30	9
(1/2 in.) on furring	1.19	0.26	0.23	0.25	0.27	0.37	0.24	0.21	0.23	0.24	0.34	10
(3/4 in.) on gypsum bd. (3/8 in.)	2.10	0.21	0.19	0.20	0.21	0.26	0.20	0.18	0.19	0.20	0.26	11
(3/4 in.) on furring	1.78	0.23	0.20	0.22	0.23	0.30	0.21	0.19	0.20	0.21	0.28	12
Wood lath and 1/2 in. plas. (sand agg.)	0.40	0.33	0.28	0.31	0.34	0.52	0.29	0.26	0.28	0.30	0.46	13

^a Pitch of roof—45 deg.

^b To adjust U values for the effect of added insulation between framing members, see Table E-12.

^c When insulation is installed between rafters, the space above should be ventilated and in this case the roof construction is disregarded in calculation of U values. To adjust U values for pitched roof construction with added insulation between framing members, use the average of values for horizontal and vertical heat flow in A, Table E-12 and either C or D, E-12 depending on direction of heat flow.

Table E-18.① Determination of U Value Resulting from Addition of Insulation or Air Spaces to Uninsulated Building Sections*

PART A. WALLS*

U Value ^b Without Added Insulation	Fibrous Insulation ^c Thickness—Inches				One Air Space of Effective Emissivity E			Two Air Spaces of Effective Emissivity E			Three Air Spaces of Effective Emissivity E		
	½	1	2	3	0.82 ^d	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
	Col. 1	2	3	4	5	6	7	8	9	10	11	12	13
0.70	0.304	0.194	0.113	0.080	0.752	0.463	0.380	0.437	0.240	0.189	0.298	0.150	0.112
0.60	0.284	0.186	0.110	0.078	0.630	0.412	0.341	0.392	0.225	0.177	0.276	0.144	0.108
0.45	0.246	0.168	0.104	0.075	0.460	0.331	0.280	0.318	0.195	0.158	0.237	0.130	0.098
0.40	0.230	0.161	0.101	0.074	0.409	0.299	0.258	0.291	0.185	0.149	0.222	0.125	0.095
0.35	0.212	0.152	0.097	0.072	0.354	0.267	0.234	0.262	0.172	0.140	0.205	0.119	0.092
0.30	0.192	0.142	0.093	0.069	0.30	0.234	0.207	0.232	0.158	0.130	0.188	0.112	0.087
0.28	0.184	0.138	0.091	0.068	0.28	0.221	0.196	0.220	0.151	0.125	0.178	0.108	0.084
0.26	0.175	0.133	0.089	0.066	0.26	0.206	0.185	0.207	0.144	0.120	0.169	0.104	0.082
0.24	0.166	0.127	0.087	0.065	0.24	0.194	0.173	0.194	0.137	0.115	0.160	0.100	0.079
0.22	0.156	0.121	0.084	0.064	0.22	0.180	0.161	0.180	0.129	0.110	0.150	0.096	0.076
0.20	0.145	0.115	0.081	0.062	0.20	0.165	0.149	0.166	0.120	0.104	0.140	0.091	0.073
0.18	0.134	0.108	0.078	0.060	0.18	0.150	0.137	0.152	0.112	0.098	0.129	0.086	0.069
0.16	0.123	0.100	0.074	0.057	0.16	0.136	0.124	0.137	0.103	0.090	0.118	0.080	0.065
0.14	0.111	0.092	0.069	0.054	0.14	0.120	0.111	0.122	0.094	0.083	0.106	0.075	0.061
0.12	0.098	0.083	0.064	0.051	0.12	0.105	0.098	0.107	0.084	0.075	0.094	0.068	0.056
0.10	0.085	0.073	0.058	0.047	0.10	0.089	0.084	0.091	0.074	0.066	0.082	0.061	0.051
0.08	0.070	0.062	0.050	0.042	0.08	0.073	0.068	0.074	0.062	0.056	0.068	0.053	0.045

* For constructions with air spaces as insulation, coefficients are based on National Bureau of Standards data in Housing Research Paper No. 32 (U. S. Government Printing Office, Washington, D. C.).

^a Based on an indoor-outdoor temperature difference of 70 F deg, and a mean temperature of 50 F. Values are applicable conservatively to winter and summer conditions.

^b U value taken from Tables E-10 and E-11 based on one nonreflective 3-in. air space between framing members.

^c Thermal conductivity of fibrous or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

^d Certain U values in Column 6 differ from Column 1 because they are adjusted to the specific temperature drop across the air space in question as affected by the U value of the construction.

PART B. FLOORS^e—HEAT FLOW DOWN

U Value ^f Without Added Insulation	Fibrous Insulation ^g Thickness—Inches				One Air Space of Effective Emissivity E			Two Air Spaces of Effective Emissivity E			Three Air Spaces of Effective Emissivity E		
	½	1	2	3	0.82	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
	Col. 1	2	3	4	5	6	7	8	9	10	11	12	13
0.70	0.305	0.195	0.113	0.080	0.70	0.240	0.114	0.377	0.122	0.057	0.262	0.086	0.042
0.60	0.284	0.186	0.110	0.078	0.60	0.236	0.111	0.346	0.118	0.056	0.246	0.084	0.041
0.50	0.260	0.175	0.106	0.076	0.50	0.210	0.106	0.310	0.114	0.055	0.228	0.082	0.041
0.45	0.246	0.168	0.104	0.075	0.45	0.200	0.103	0.290	0.111	0.055	0.217	0.081	0.040
0.40	0.230	0.161	0.101	0.074	0.40	0.189	0.100	0.268	0.107	0.054	0.205	0.079	0.040
0.35	0.212	0.152	0.097	0.072	0.35	0.178	0.096	0.244	0.103	0.052	0.192	0.077	0.040
0.30	0.192	0.142	0.093	0.069	0.30	0.162	0.091	0.219	0.098	0.051	0.175	0.074	0.039
0.28	0.184	0.138	0.091	0.068	0.28	0.156	0.089	0.208	0.096	0.050	0.168	0.073	0.039
0.26	0.175	0.133	0.089	0.066	0.26	0.150	0.087	0.197	0.094	0.049	0.161	0.072	0.038
0.24	0.166	0.127	0.087	0.065	0.24	0.143	0.084	0.185	0.091	0.048	0.153	0.070	0.038
0.22	0.156	0.121	0.084	0.064	0.22	0.136	0.081	0.173	0.088	0.047	0.145	0.068	0.037
0.20	0.145	0.115	0.081	0.062	0.20	0.128	0.078	0.160	0.084	0.046	0.136	0.066	0.036
0.18	0.134	0.108	0.078	0.060	0.18	0.119	0.074	0.148	0.080	0.045	0.126	0.064	0.036
0.16	0.123	0.100	0.074	0.057	0.16	0.109	0.070	0.133	0.076	0.044	0.116	0.061	0.035
0.14	0.111	0.092	0.069	0.054	0.14	0.099	0.065	0.118	0.071	0.042	0.105	0.058	0.034
0.12	0.098	0.083	0.064	0.051	0.12	0.088	0.060	0.103	0.066	0.040	0.094	0.054	0.033
0.10	0.085	0.073	0.058	0.047	0.10	0.076	0.054	0.089	0.058	0.037	0.081	0.049	0.031
0.08	0.070	0.062	0.050	0.042	0.08	0.063	0.047	0.072	0.050	0.033	0.068	0.044	0.028

* For construction with air spaces as insulation, coefficients are based on National Bureau of Standards data in Housing Research Paper No. 32 (U. S. Government Printing Office, Washington, D. C.).

^e Based on a temperature difference of 80 F deg from air to air, and a mean temperature of 50 F.

^f U value taken from Tables E-7 and E-8 in which it is assumed that the air space between joists or above the suspended ceiling is nonreflective (E = 0.82), and is 8 in. thick.

^g Thermal conductivity of fibrous or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

Table E-12.② Determination of U Value Resulting from Addition of Insulation or Air Spaces to Uninsulated Building Sections*—Continued

PART C. CEILINGS—HEAT FLOW UP^h (WINTER CONDITION)

U Value ⁱ Without Added Insulation	Fibrous Insulation ^j Thickness—Inches				One Air Space of Effective Emissivity E			Two Air Spaces of Effective Emissivity E			Three Air Spaces of Effective Emissivity E		
	½	1	2	3	0.82 ^k	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.70	0.305	0.195	0.113	0.080	0.690	0.472	0.403	0.427	0.262	0.216	0.307	0.180	0.146
0.60	0.284	0.186	0.110	0.078	0.588	0.417	0.362	0.385	0.244	0.204	0.284	0.171	0.139
0.50	0.260	0.175	0.106	0.076	0.488	0.361	0.318	0.339	0.224	0.189	0.258	0.160	0.131
0.45	0.246	0.168	0.104	0.075	0.438	0.331	0.295	0.316	0.212	0.180	0.243	0.154	0.126
0.40	0.230	0.161	0.101	0.074	0.389	0.300	0.270	0.288	0.199	0.170	0.227	0.146	0.121
0.35	0.212	0.152	0.097	0.072	0.340	0.269	0.244	0.260	0.185	0.158	0.209	0.138	0.115
0.30	0.192	0.142	0.093	0.069	0.292	0.237	0.215	0.230	0.168	0.145	0.189	0.129	0.108
0.28	0.184	0.138	0.091	0.068	0.272	0.224	0.203	0.217	0.161	0.140	0.181	0.125	0.104
0.26	0.175	0.133	0.089	0.066	0.253	0.211	0.191	0.204	0.154	0.134	0.172	0.120	0.101
0.24	0.166	0.127	0.087	0.065	0.234	0.199	0.179	0.191	0.146	0.128	0.163	0.115	0.097
0.22	0.156	0.121	0.084	0.064	0.214	0.186	0.166	0.178	0.137	0.120	0.153	0.109	0.093
0.20	0.145	0.115	0.081	0.062	0.195	0.173	0.154	0.164	0.128	0.114	0.143	0.104	0.088
0.18	0.134	0.108	0.078	0.060	0.176	0.159	0.141	0.150	0.119	0.106	0.132	0.097	0.084
0.16	0.123	0.100	0.074	0.057	0.156	0.146	0.128	0.136	0.109	0.098	0.121	0.090	0.079
0.14	0.111	0.092	0.069	0.054	0.137	0.132	0.115	0.120	0.099	0.090	0.109	0.083	0.073
0.12	0.098	0.083	0.064	0.051	0.118	0.118	0.101	0.105	0.088	0.080	0.096	0.075	0.068
0.10	0.085	0.073	0.058	0.047	0.099	0.105	0.088	0.090	0.076	0.071	0.082	0.067	0.062
0.08	0.070	0.062	0.050	0.042	0.079	0.091	0.074	0.073	0.064	0.061	0.067	0.058	0.056

* For construction with air spaces as insulation, coefficients are based on National Bureau of Standards data in *Housing Research Paper No. 32* (U. S. Government Printing Office, Washington, D. C.).

^h Based on a temperature of 75 F deg from air to air, and a mean temperature of 40 F.

ⁱ U value taken from Tables E-7, E-8; A, E-9; A, E-10 and E-11 in which it is assumed that air space between joists or above the suspended ceiling is nonreflective (E = 0.82), and is 8 in. thick.

^j Thermal conductivity of fibrous or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

^k Certain U values in Column 6 differ from Column 1 because they are adjusted to the specific temperature drop across the air space in question as affected by the U value of the construction.

PART D. CEILINGS—HEAT FLOW DOWN^l (SUMMER CONDITION)

U Value ^m Without Added Insulation	Fibrous Insulation ⁿ Thickness—Inches				One Air Space of Effective Emissivity E			Two Air Spaces of Effective Emissivity E			Three Air Spaces of Effective Emissivity E		
	½	1	2	3	0.82	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.70	0.305	0.195	0.113	0.080	0.704	0.269	0.119	0.423	0.144	0.061	0.306	0.103	0.046
0.60	0.284	0.186	0.110	0.078	0.602	0.252	0.116	0.384	0.139	0.060	0.284	0.100	0.046
0.50	0.260	0.175	0.106	0.076	0.501	0.231	0.112	0.340	0.133	0.059	0.260	0.097	0.045
0.45	0.246	0.168	0.104	0.075	0.450	0.220	0.108	0.316	0.128	0.058	0.246	0.095	0.044
0.40	0.230	0.161	0.101	0.074	0.400	0.206	0.105	0.291	0.123	0.057	0.230	0.092	0.044
0.35	0.212	0.152	0.097	0.072	0.350	0.192	0.100	0.264	0.118	0.056	0.213	0.090	0.043
0.30	0.192	0.142	0.093	0.069	0.300	0.175	0.095	0.234	0.112	0.055	0.193	0.086	0.042
0.28	0.184	0.138	0.091	0.068	0.280	0.168	0.093	0.222	0.109	0.054	0.185	0.085	0.042
0.26	0.175	0.133	0.089	0.066	0.260	0.160	0.090	0.209	0.105	0.054	0.176	0.083	0.041
0.24	0.166	0.127	0.087	0.065	0.240	0.152	0.087	0.195	0.102	0.053	0.167	0.080	0.040
0.22	0.156	0.121	0.084	0.064	0.220	0.144	0.084	0.182	0.098	0.052	0.157	0.078	0.040
0.20	0.145	0.115	0.081	0.062	0.200	0.135	0.081	0.168	0.094	0.050	0.146	0.075	0.039
0.18	0.134	0.108	0.078	0.060	0.180	0.125	0.077	0.154	0.089	0.049	0.135	0.072	0.038
0.16	0.123	0.100	0.074	0.057	0.160	0.115	0.073	0.139	0.084	0.047	0.124	0.068	0.038
0.14	0.111	0.092	0.069	0.054	0.140	0.104	0.069	0.124	0.078	0.045	0.111	0.064	0.037
0.12	0.098	0.083	0.064	0.051	0.120	0.093	0.063	0.108	0.072	0.042	0.098	0.059	0.035
0.10	0.085	0.073	0.058	0.047	0.099	0.080	0.056	0.091	0.064	0.039	0.084	0.054	0.033
0.08	0.070	0.062	0.050	0.042	0.079	0.068	0.048	0.074	0.054	0.034	0.070	0.046	0.030

^l Based on a temperature difference of 35 F deg from air to air, and a mean temperature of 100 F.

^m U value taken from Tables 10, 11, 12B, 13B, and 14, in which it is assumed that the air space between joists or above the suspended ceiling is nonreflective (E = 0.82), and is 8 in. thick.

ⁿ Thermal conductivity or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

Table E-12.③ Determination of U Value Resulting from Addition of Insulation to Uninsulated Building Section *—Continued

(For use with A and B, Table E-9)

PART E. FLAT ROOFS AND CEILINGS WITH ROOF DECK

U Value of Roof without Roof-Deck Insulation*	Conductance C of Roof-Deck Insulation					
	0.12	0.15	0.19	0.24	0.36	0.72
	U	U	U	U	U	U
0.10	0.05	0.06	0.07	0.07	0.08	0.09
0.15	0.07	0.08	0.08	0.09	0.11	0.12
0.20	0.08	0.09	0.10	0.11	0.13	0.16
0.25	0.08	0.09	0.11	0.12	0.15	0.19
0.30	0.09	0.10	0.12	0.13	0.16	0.21
0.35	0.09	0.10	0.12	0.14	0.18	0.24
0.40	0.09	0.11	0.13	0.15	0.19	0.26
0.50	0.10	0.12	0.14	0.16	0.21	0.29
0.60	0.10	0.12	0.14	0.17	0.22	0.33
0.70	0.10	0.12	0.15	0.18	0.24	0.35

* Interpolation or mild extrapolation may be used.

Table E-13. Estimated Heat Loss by Building Infiltration

The tabulated factors when multiplied by room or building volume (cu ft) will result in estimated heat loss (Btu/hr) due to infiltration and does not include the heat needed to warm ventilating air

Room or Building Type	No. of walls with windows	Temp. difference, F deg			
		25	50	75	100
A	None	0.23	0.45	0.68	0.90
	1	0.34	0.68	1.02	1.36
	2	0.68	1.35	2.02	2.70
	3 or 4	0.90	1.80	2.70	3.60
B	Any	1.35	2.70	4.05	5.40
C	Any	0.90-1.35	1.80-2.70	2.70-4.05	3.60-5.40
D	Any	0.45-0.68	0.90-1.35	1.35-2.02	1.80-2.70
E	Any	0.68-1.35	1.35-2.70	2.03-4.05	2.70-5.40

- A = Offices, apartments, hotels, multistory buildings in general.
- B = Entrance halls or vestibules.
- C = Industrial buildings.
- D = Houses, all types, all rooms except vestibules.
- E = Public or institutional buildings.

Table E-14. Effective Resistance of Ventilated Attics (Summer Conditions).

PART A. NON-REFLECTIVE SURFACES

Ventilation Air temp., F	Sol-air ^c temp., F	No Ventilation		Natural Ventilation		Power Ventilation ^d					
		Ventilation rate, cfm/sq ft									
		0		0.1		0.5		1.0		1.5	
		1/U Ceiling resistance, r _v ^b									
80	120	1.9	1.9	2.8	3.4	6.3	9.3	9.6 ^e	16	11	20
	140	1.9	1.9	2.8	3.6	10	9.8	17	12	21	
	160	1.9	1.9	2.8	3.6	6.7	11	10	18	13	22
90	120	1.9	1.9	2.5	2.8	4.6	6.7	6.1	10	6.9	13
	140	1.9	1.9	2.6	3.1	5.2	7.3	7.6	12	8.6	16
	160	1.9	1.9	2.7	3.4	5.8	9.0	8.6	14	10	17
100	120	1.9	1.9	2.2	2.3	3.3	4.4	4.0	6.0	4.1	6.9
	140	1.9	1.9	2.4	2.7	4.2	6.1	5.8	8.7	6.5	10
	160	1.9	1.9	2.6	3.2	5.0	7.6	7.3	11	8.5	13

PART B. REFLECTIVE SURFACES^e

80	120	6.5	6.5	8.1	8.8	13	17	17	25	19	30
	140	6.5	6.5	8.2	9.0	14	18	18	26	20	31
	160	6.5	6.5	8.3	9.2	15	18	19	27	21	32
90	120	6.5	6.5	7.5	8.0	10	13	12	17	13	19
	140	6.5	6.5	7.7	8.3	12	15	14	20	16	22
	160	6.5	6.5	7.9	8.6	13	16	16	22	18	25
100	120	6.5	6.5	7.0	7.4	8.0	10	8.6	12	8.8	12
	140	6.5	6.5	7.3	7.8	10	12	11	15	12	16
	160	6.5	6.5	7.6	8.2	11	14	13	18	15	20

^a The term *effective resistance* is used when there is attic ventilation. A value for no ventilation is also included. The effective resistance of the attic may be added to the resistance (1/U) of the ceiling (Table E-12 Part D) to obtain the effective resistance of the combination based on sol-air. These values apply to wood frame construction with a roof deck and roofing having a conductance of 1.0 Btu/(sq ft) (hr) (°F deg).

^b *Resistance in one (hr) (sq ft) (F deg) per Btu.* Determine ceiling resistance from Tables 10 and 15, and correct for framing by Fig. 4. Do not add the effect of a reflective surface facing the attic to the ceiling resistance from Table E-12 Part D, as it is accounted for in Table E-14 Part B.

^c *Roof surface temperature rather than sol-air temperature* may be used if 0.25 is subtracted from the attic resistance shown.

^d *Based on air discharging outward from attic.*

^e *Surfaces with effective emissivity E of 0.08 between ceiling joists facing the attic space.*

Table E-15. Coefficients of Transmission (U) of Windows, Skylights, and Light Transmitting Partitions.

Btu per (hr) (sq ft) (F Deg)

PART A—VERTICAL PANELS (EXTERIOR WINDOWS AND PARTITIONS)—FLAT GLASS, GLASS BLOCK, AND PLASTIC SHEET

Description	Exterior ^a		Interior
	Winter	Summer	
Flat Glass single glass	1.13	1.06	0.73
insulating glass—double ^b			
1/4 in. air space	0.69	0.64	0.5
1/2 in. air space	0.65	0.61	0.4
3/4 in. air space	0.58	0.56	0.4
insulating glass—triple ^b			
1/4 in. air spaces	0.47	0.45	0.38
1/2 in. air spaces	0.36	0.35	0.30
storm windows			
1 in.—4 in. air space	0.56	0.54	0.44
Glass Block ^c			
6 × 6 × 4 in. thick	0.60	0.57	0.46
8 × 8 × 4 in. thick	0.56	0.54	0.44
—with cavity divider	0.48	0.46	0.38
12 × 12 × 4 in. thick	0.52	0.50	0.41
—with cavity divider	0.44	0.42	0.36
12 × 12 × 2 in. thick	0.60	0.57	0.46
Single Plastic Sheet	1.00	1.00	0.70

Btu per (hr) (sq ft) (F Deg)

PART B—HORIZONTAL PANELS (SKYLIGHTS)—FLAT GLASS, GLASS BLOCK, AND PLASTIC BUBBLES

Description	Exterior ^a		Interior ^d
	Winter ^d	Summer ^e	
Flat Glass single glass	1.22	0.83	0.96
insulating glass—double ^b —			
1/4 in. air space	0.75	0.49	0.62
1/2 in. air space	0.70	0.46	0.59
3/4 in. air space	0.66	0.44	0.56
Glass Block ^c			
11 × 11 × 3 in. thick with cavity divider	0.53	0.35	0.44
12 × 12 × 4 in. thick with cavity divider	0.51	0.34	0.42
Plastic Bubbles ^f			
single walled	1.15	0.80	—
double walled	0.70	0.46	—

PART C—ADJUSTMENT FACTORS FOR VARIOUS WINDOW TYPES (MULTIPLY U VALUES IN PARTS A AND B BY THESE FACTORS)

Window Description	Single Glass	Double or Triple Glass	Storm Windows
All Glass ^a	1.00	1.00	1.00
Wood Sash—80% Glass	0.90	0.95	0.90
Wood Sash—60% Glass	0.80	0.85	0.80
Metal Sash—80% Glass	1.00	1.20	1.20 ^b

^a See Part C for adjustment for various window types.
^b Double and triple refer to the number of lights of glass.
^c Dimensions are nominal.
^d For heat flow up.
^e For heat flow down.
^f Based on area of opening, not total surface area.
^g Refers to windows with negligible opaque area.
^h Value becomes 1.00 when storm sash is separated from prime window by a thermal break.

Table E-16. Coefficients of Transmission (U) for Solid Wood Doors

Btu per (hr) (sq ft) (F Deg)

Thickness ^a	Winter			Summer No Storm Door
	No Storm Door	Storm Door ^b		
		Wood	Metal	
1 in.	0.61	0.30	0.39	0.61
1 1/2 in.	0.55	0.28	0.34	0.53
1 3/4 in.	0.49	0.27	0.33	0.47
2 in.	0.43	0.24	0.29	0.42

^a Nominal thickness.
^b Values for wood storm doors are for approximately 50 percent glass; for metal storm doors values apply for any percent of glass.

Table E-17. Conversion Table for Wall Coefficient U for Various Wind Velocities

U for 15 mph ^a	U for 0 to 30 mph Wind Velocities					
	0	5	10	20	25	30
0.050	0.049	0.050	0.050	0.050	0.050	0.050
0.060	0.059	0.059	0.060	0.060	0.060	0.060
0.070	0.068	0.069	0.070	0.070	0.070	0.070
0.080	0.078	0.079	0.080	0.080	0.080	0.080
0.090	0.087	0.089	0.090	0.090	0.091	0.091
0.100	0.096	0.099	0.100	0.100	0.101	0.101
0.110	0.105	0.108	0.109	0.110	0.111	0.111
0.130	0.123	0.127	0.129	0.131	0.131	0.131
0.150	0.141	0.147	0.149	0.151	0.151	0.152
0.170	0.158	0.166	0.169	0.171	0.172	0.172
0.190	0.175	0.184	0.188	0.191	0.192	0.193
0.210	0.192	0.203	0.208	0.212	0.213	0.213
0.230	0.209	0.222	0.227	0.232	0.233	0.234
0.250	0.226	0.241	0.247	0.252	0.253	0.254
0.270	0.241	0.259	0.266	0.273	0.274	0.275
0.290	0.257	0.278	0.286	0.293	0.295	0.296
0.310	0.273	0.296	0.305	0.313	0.315	0.317
0.330	0.288	0.314	0.324	0.333	0.336	0.338
0.350	0.303	0.332	0.344	0.354	0.357	0.359
0.370	0.318	0.350	0.363	0.375	0.378	0.380
0.390	0.333	0.368	0.382	0.395	0.399	0.401
0.410	0.347	0.385	0.402	0.416	0.420	0.422
0.430	0.362	0.403	0.421	0.436	0.441	0.444
0.450	0.376	0.420	0.439	0.457	0.462	0.465
0.500	0.410	0.464	0.487	0.509	0.514	0.518
0.600	0.474	0.548	0.581	0.612	0.620	0.626
0.700	0.535	0.631	0.675	0.716	0.728	0.736
0.800	0.592	0.711	0.766	0.821	0.836	0.847
0.900	0.645	0.789	0.858	0.927	0.946	0.960
1.000	0.695	0.865	0.949	1.034	1.058	1.075
1.100	0.742	0.939	1.039	1.142	1.170	1.192
1.200	0.786	1.010	1.129	1.250	1.285	1.318
1.300	0.828	1.080	1.217	1.359	1.400	1.430

^a U in first column is from previous tables or as calculated for 15 mph wind velocity.